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12 UNITED STATES DISTRICT COURT
13 NORTHERN DISTRICT OF CALIFORNIA, SAN FRANCISCO DIVISION

14
15 IN RE SEAGATE TECHNOLOGY LLC
16 LITIGATION

17 CONSOLIDATED ACTION

Case No. 3:16-cv-00523-JCS

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**DECLARATION OF DONALD ADAMS,
PE IN SUPPORT OF SEAGATE'S
OPPOSITION TO PLAINTIFFS'
MOTION FOR CLASS CERTIFICATION**

Date: March 30, 2018
Time: 9:30 a.m.
Place: Courtroom G
Judge: Hon. Joseph C. Spero

Second Consolidated Amended Complaint
filed: July 11, 2016

UNREDACTED VERSION OF DOCUMENT SOUGHT TO BE SEALED

Table of Contents

1	I. Summary of Relevant Experience	1
2	II. Hard Drives and Products at Issue	2
3	III. Summary of Opinions	4
4	A. H ospodor fails to support his claims that the ST3000DM001 drives had a 5 “higher than advertised” AFR	4
6	B. H ospodor’s claims that Seagate’s testing underestimated the “true” AFR of 7 the drives is based on misinterpretation of Seagate’s documents and 8 misapplication of principles of failure analysis	6
9	C. H ospodor fails to support any conclusion that Seagate’s internal, desktop 10 ST3000DM001 products had an AFR above 1% across the class period and 11 across different versions of the ST3000DM001 (Grenada Classic, Grenada BP 12 and Grenada BP2), or that the drives had any problem common throughout 13 the class period (2011-2016), or common to the products and drive versions at 14 issue	8
15	D. H ospodor fails to support the claim that Seagate’s reliability testing and 16 quality control process were flawed	10
17	E. H ospodor does not justify the claim that the ST3000DM001 drives (Grenada 18 Classic, BP and BP2) were released for production before the design and 19 manufacturing process were properly qualified to meet product and business 20 goals, and unreasonably concludes the ST3000DM001 was inherently 21 ‘unstable’ and ‘unreliable’	10
22	F. H ospodor’s opinions are not based on sufficient data and are not the product 23 of accepted principles of reliability analysis correctly applied to Seagate data	12
24	IV. Reliability Testing, AFR, and Seagate’s Drive Development Process	12
25	A. Data from Reliability Testing Is Used to Estimate the Weibull Distribution 26 Parameters and Calculate Projected AFR (and MTBF)	12
27	B. Seagate Always Estimated the Weibull Parameters and Calculated the 28 Projected AFR for the Grenada Drives from Actual Test Data – It Did Not 29 “Assume” Beta	15
30	C. H ospodor Makes Several Misstatements about AFR and MTBF in His 31 Sections IV.C.1 and IV.C.2	17
32	D. Seagate’s Usage Estimates Were Reasonable	18
33	E. Seagate’s Drive Development and Manufacturing Process Was Appropriate 34 and Consistent with Industry Standards – Including Release of Drives to SBS 35 before Release to Disty	20
36	V. H ospodor’s Claims about the “Advertised” AFR of the Drives Are Not Supported 37 (H ospodor’s Section IV.E)	22

1	VI.	Hospodor Fails to Support His Claims that the ST3000DM001 Drives Had a “Higher than Advertised” AFR	23
2	A.	The Majority of Hospodor’s Analysis Relates to SBS Products	23
3	B.	Hospodor’s Claims Regarding Grenada Drives Used in Internal (Disty) Products Are Not Supported by the Document He Cites	25
4	C.	Only Two Documents Contain AFRs above 1% for Internal (Disty) Drives, but the Drives at Issue Did Not Reach Consumers	27
5	VII.	Hospodor’s Opinion that “Seagate’s Reliability Testing Underestimated the True AFR of the Drive” Is Not Based on Sufficient Evidence nor Accepted Principles of Reliability Analysis	28
6	A.	Seagate Did Not ‘Assume,’ ‘Select’ or Use a Pre-Selected Beta Value of <1	28
7	B.	Hospodor’s Opinion Makes No Sense	29
8	C.	Hospodor’s Three Pieces of Evidence Do Not Support His Opinion	29
9	1.	The Sequence of “Increasing” AFRs	29
10	2.	Hospodor’s Reliance on Khurshudov Is Misplaced	31
11	3.	The Grenada BP2 Test Results	35
12	D.	The Backblaze Blog Posts Do Not Support Hospodor’s Conclusions	36
13	VIII.	Hospodor’s Remaining Sections and Evidence Do Not Support Any Claims about the AFR of the Drives or Hospodor’s Claim that the Drives Were Released Prematurely or Were ‘Unstable’ and ‘Unreliable’ (Hospodor’s Section IV.I)	37
14	A.	Yield Information (Hospodor’s Section IV.I.1)	38
15	B.	Engineering Change Requests (ECRs) Are Not Evidence of AFR or that the Drives Were Unstable or Shipped Prematurely”	40
16	C.	Hospodor’s Discussion of Firmware Revisions Does Not Support His Claims (Hospodor’s Section IV.I.2(c))	44
17	D.	Hospodor’s Discussion of Ship Holds Does Not Support His Opinion (Hospodor Section IV.I.2(d) and IV.I.2(e))	46
18	E.	Hospodor Does Not Support His Claim that Seagate Documents “Acknowledge” that the Drives Were “Unstable, Unreliable, and Defective” ” (Hospodor’s Section IV.I.2(f).)	47
19	F.	A Few Changed Specifications for the Drives Do Not Support Hospodor’s Claim that the Drives Were “Unreliable” (Hospodor’s Section IV.J)	47
20	IX.	Hospodor Does not Identify Any Defect or Other Issue Common to the Different Drive Versions, Products, or Across the Class Period	50
21	X.	Supplementation of Opinions	53

DECLARATION OF DONALD ADAMS, PE

2 1. I have been retained as an expert by Defendant Seagate Technology, LLC
3 ("Seagate") to provide an analysis and rebuttal of the Declaration of Andrew Hospodor
4 ("Hodpodor") that Plaintiffs submitted in support of their Motion for Class Certification.

5 2. Specifically, I was asked to evaluate:

- (a) whether the evidence Hospodor cites support his opinions in his Declaration;
- (b) whether Hospodor presented evidence that Seagate's internal, desktop ST3000DM001 products had an AFR above 1% across the class period (2011-2016) and across the different versions of the ST3000DM001 (Grenada Classic, Grenada BP and Grenada BP2);
- (c) whether Hospodor's opinions are based on sufficient data and are the product of accepted principles of reliability analysis correctly applied to the information and data he cites.

I. Summary of Relevant Experience

3. My experience is primarily in the design and development of HDDs since the early 1980's. I started as an electrical engineer designing magnetic recording data channels while completing my studies in communications systems at Santa Clara University. A significant part of my formal training was in Probability Theory. By the 1990's I was increasingly responsible for the complete design of HDD products at Maxtor, SyQuest, Quantum and then Maxtor again as a Project Engineer/Manager and Engineering Director. By the early 2000's I had been the responsible engineer for more than five HDD products from early design, to development and qualification, through transfer to high volume manufacturing. I have contributed to the design of more than ten HDD and related products that have gone into high volume production. At various times throughout my career I have conducted or supervised reliability testing and analysis on hard drives.

4. During this time I also worked on product/technology development and planning. This work led to integration of important technologies to advance areal density, reduce operational costs, and/or develop new applications for HDDs. Of note is the joint development of the Digital Video Recorder with TiVo and other related consumer media products at Quantum. I also led numerous special task forces to resolve critical factory and customer problems for yield and/or reliability which resulted in new design and development processes.

1 5. Both Dr. Hospodor and I worked at Quantum in the late 1990s and early 2000s where
 2 I was responsible for several HDD products through product qualifications and transfer to
 3 manufacturing. This included reliability testing and analysis. To my knowledge, Dr. Hospodor was
 4 only peripherally involved in this type of work at Quantum.

5 6. More recently I have continued to work or consult as a senior engineering manager
 6 and electrical engineer. After leaving Maxtor I led the engineering team at Nanochip in a joint
 7 technology development with Intel for probe storage based on MEMS technology and Atomic Force
 8 Microscopy. Since 2009 I have focused mainly on my consulting practice with a four year stint at
 9 Western Digital from 2011 through 2015. During this time, I was involved in defining the
 10 architecture and design of hybrid HDD electronics. This included qualification testing (reliability
 11 testing and analysis) of the first products. I also worked on special problems in signal/power
 12 integrity and Electromagnetic Compatibility.

13 7. I hold a Master of Science degree in Electrical Engineering (MSEE) from Santa Clara
 14 University and a Bachelor of Science degree in Electrical Engineering (BSEE) from San Jose State
 15 University. I am also a registered Professional Electrical Engineer in California, # E-19198, and
 16 continue to practice in the field.

17 8. My curriculum vitae is attached as Appendix 1 hereto. The materials I reviewed in
 18 preparing this declaration are listed in Appendix 2.

19 9. I am presently being compensated for my work in this matter at my current billing
 20 rate of \$350 per hour. My compensation is not dependent on the opinions that I provide or the
 21 outcome of this litigation.

22 **II. Hard Drives and Products at Issue**

23 10. In 2011, Seagate began manufacturing a computer hard disk drive (“HDD”) bearing
 24 model number ST3000DM001. HDD technology was first developed by IBM in the 1950s to
 25 provide high performance mass data storage for computer systems of that era. It is based on
 26 magnetic recording of bits of data in a layer of material on rotating disks (or “platters”) by means of
 27 a read-write head that flies over the surface of the disks to access the data. Both the size and
 28 capacity of HDDs have evolved since then to provide tremendous capability that enabled

1 widespread personal computing and big-data applications today.

2 11. Within Seagate, the ST3000DM001 was known by the internal codename Grenada.
 3 (Dewey Decl., ¶ 6.) The Grenada drives had a new, industry leading “areal density” of 1 TB per
 4 platter at the time. (Dewey Decl., ¶ 22.) The ST3000DM001 was the 3 terabyte (3TB) member of
 5 the Grenada family, meaning it had 3 platters of 1 TB each. It also had a total of 6 read-write heads
 6 (2 per platter). There were two other Grenada drive sizes – a 1TB drive with at least 1 platter (and 2
 7 read-write heads), and a 2TB drive with at least 2 platters (and 4 read-write heads total). (Dewey
 8 Decl., ¶ 24.) There were three different versions of the Grenada drives, the original Grenada Classic
 9 that Seagate started manufacturing in 2011, the Grenada Block Point or Grenada BP, which Seagate
 10 started manufacturing in 2012, and the Grenada BP2, which Seagate started manufacturing in 2014.
 11 (Ex. 3 [FED_SEAG0026867] at 26868; Ex. 5 [FED_SEAG0057277]; Dewey Decl., ¶ 6.) The
 12 Grenada BP and the Grenada BP2 each had several significant modifications over the prior version.
 13 (*Ibid.*) Unless otherwise noted, I will use the terms “Grenada drives” and “ST3000DM001 drives”
 14 to refer to all three versions of the **3TB** Grenada/ST3000DM001 drives.

15 12. The Grenada drives were included in two different groups of products—external,
 16 USB products (SBS products), and internal, desktop products (Disty products). The external, USB
 17 (SBS) products are stand-alone backup storage devices that connect to a computer through a USB
 18 cable.¹ These products contain at least a hard drive, in a separate enclosure or box, USB connectors
 19 to connect the product to a computer, and usually an independent power supply. The internal,
 20 desktop products were “bare” drives that users had to install in their own desktop computer or other
 21 device.²

22
 23
 24 ¹ These products are the Desktop External Drive, BackUp Plus Mac, BackUp Plus Desk,
 25 FreeAgent GoFlex Desk, FreeAgent GoFlex Home, GoFlex Desk for Mac, FreeAgent GoFlex
 26 Home, Expansion Desk, Expansion Desk Plus. That H ospodor cites in his paragraphs 23 and 26.
 27 *See e.g.*, H ospodor Decl., ¶¶ 23, 26, and footnote 3.

28 ² The “Disty” drives were sold for use as internal, desktop hard drives. This means they
 29 were sold as drives without any external box or enclosure of their own and needed to be installed
 30 into desktop computers or backup systems by consumers. These products were the Barracuda and
 31 Desktop HDD Internal Kit drives. *See e.g.*, H ospodor Decl., ¶¶ 23, 26, and footnote 3. The Desktop
 32 HDD Internal Kit was the replacement name for the Barracuda. Both were “Disty” products.
 (Dewey Decl., ¶ 7.)

1 13. It is my understanding that Plaintiffs define the relevant period (the “class period”) as
 2 from the earliest release of the ST3000DM001 drives to February 1, 2016. (Hospodor Decl.,
 3 footnote 1.) Since the first version of the ST3000DM001 drives was first approved for release as an
 4 external, USB product in April, 2011 (Ex. 1 [FED_SEAG0026697]), I assume the proposed class
 5 period to be April, 2011 – February, 2016.

6 14. Unless otherwise noted, Exhibits referred to in this declaration are Exhibits to the
 7 Declaration of Lién Payne filed concurrently herewith.

8 **III. Summary of Opinions**

9 15. There are numerous problems with the opinions expressed in Dr. Hospodor’s
 10 declaration. Specifically:

- 11 A. Hospodor fails to support his claims that the ST3000DM001 drives had a higher
 than advertised AFR;
- 12 B. Hospodor’s claim that Seagate’s testing “underestimated” the “true” AFR of the
 drives makes no sense, and is based on misinterpretation of Seagate’s documents
 and misapplication of principles of failure analysis;
- 13 C. Hospodor fails to support any conclusion that Seagate’s internal, desktop
 ST3000DM001 products had an AFR above 1% across the class period and
 across different versions of the ST3000DM001 (Grenada Classic, Grenada BP
 and Grenada BP2), or that the ST3000DM001 drives had any problem common
 throughout the class period (2011-2016), or common to the products and drive
 versions at issue;
- 14 D. Hospodor fails to support the claim that Seagate’s reliability testing and quality
 control process were flawed;
- 15 E. Hospodor does not justify the claim that the ST3000DM001 drives (Grenada
 Classic, BP and BP2) were released for production before the design and
 manufacturing process were properly qualified to meet product and business
 goals, and unreasonably concludes the ST3000DM001 was inherently ‘unstable’
 and ‘unreliable’;
- 16 F. On the whole, Hospodor’s opinions are not based on sufficient data and are not
 the product of accepted principles of reliability analysis correctly applied to
 Seagate’s data;
- 17 A. **Hospodor fails to support his claims that the ST3000DM001 drives had a
 “higher than advertised” AFR.**

18 16. Hospodor claims that Seagate’s documents show that “the Drives” had a projected
 19 AFR that was “higher than advertised.” Hospodor’s opinions are based entirely on analyzing
 20 documents written and produced by Seagate. He does not report having performed any testing or

1 analysis of ST3000DM001 drives, or made any attempt to independently determine the failure rate
 2 of any of the drives. Hospodor's opinions rest on misinterpreting or misrepresenting Seagate's
 3 documents, and are not supported by the evidence he cites. As explained above, there are two
 4 different groups of products at issue—external, USB products (SBS products), and internal, desktop
 5 products (Disty products), and three different versions of the Grenada drive (Classic, BP and BP2).

6 a. **External, USB (SBS) Products:** The bulk of Hospodor's analysis is
 7 confined to **SBS products**, and attempting to show that when the Grenada Classic and
 8 Grenada BP were released *for use in SBS products*, the drives had a higher than 1% AFR.
 9 However, Seagate did not publish an AFR for SBS products, so his analysis is misplaced,
 10 and cannot support his conclusion that "the Drives" had a "higher than advertised" AFR.
 11 (See Sections VI.A below.) Furthermore, I have reviewed all the evidence Hospodor cites
 12 concerning the SBS products, and in my expert opinion, it cannot support a conclusion that
 13 Seagate's testing or specifications for drives used in SBS products was flawed or inadequate.
 14 (See e.g., Sections IV.D, IV.E, VII below.)

15 b. **Internal (Disty) Products:** With regard to the internal (Disty) products, the
 16 evidence available to me indicates that Seagate's AFR statements varied among products and
 17 changed over time. The evidence Hospodor cites indicates that, at most, Seagate published a
 18 0.34% AFR for the internal, desktop products for approximately 4 months. (See Section V
 19 below.) The remainder of the time it appears Seagate either published no AFR for these
 20 products, or sometimes published an AFR of "<1%". (*Id.*)

21 c. However, the documents Hospodor cites show that Seagate ***demonstrated*** that
 22 the Grenada Classic, Grenada BP and Grenada BP2 used in internal (Disty) products ***had***
 23 ***AFRs³ of <1%***. (Ex. 2⁴ [FED_SEAG0026839] at 26844 (Grenada Classic AFR was 0.95%);
 24 Ex. 4 [FED_SEAG0026751], at 26783 (Grenada BP AFR was 0.98%); Ex. 5
 25 [FED_SEAG0057277], at 57324 (Grenada BP2 AFR was 0.9%).)

26 ³ As explained further below, the AFRs discussed in this declaration are ***projected*** AFRs
 27 based on accelerated testing of populations of hard drives. Accordingly, I use the terms "AFR" and
 "projected AFR" interchangeably.

28 ⁴ As noted, exhibits referred to in this declaration are Exhibits to the Declaration of Liêm
 Payne, filed herewith.

d. Hospodor does not present any evidence that the Grenada BP or BP2 internal (Disty) drives ever had AFRs over 1%.⁵ Hospodor cites two documents showing an AFR for internal, desktop (Disty/OEM) Grenada ***Classic*** drives above 1% ***at two points in 2012***. (Section VI.C.) However, the Grenada Classic drives were subject to “ship holds” at those times, so those drives were not being shipped to customers. (*Id.*) Hospodor does not present any evidence that Grenada Classic internal (Disty) drives (or Grenada BP or BP2 Disty drives for that matter) were ever shipped to consumers with an AFR over 1%.

B. Hospodor's claims that Seagate's testing underestimated the "true" AFR of the drives is based on misinterpretation of Seagate's documents and misapplication of principles of failure analysis.

10 17. Hospodor appears to argue that even if Seagate's test data showed AFR of below 1%
11 for the internal, Disty drives, Seagate's methods of calculating AFR was flawed and underestimated
12 the "true" AFR of the drives. Hospodor claims that Seagate '*selected*' (or used a pre-selected) Beta
13 value of less than 1 to calculate projected AFRs, when in fact (according to Hospodor) Seagate
14 should have used a Beta value of greater than 1.⁶ Hospodor's assertion that Seagate should have
15 used a different value of Beta isn't supported by an accepted methodology or the evidence he cites.

16 18. As a preliminary matter, Hospodor incorrectly claims that Seagate ‘selected’ or
17 ‘assumed’ a Beta value for the Weibull distribution in order to calculate the predicted AFR for the
18 Grenada drives. This is incorrect. It is apparent from Seagate’s documents, and Seagate’s witness’s
19 prior deposition testimony and declarations, that Seagate always used industry-standard techniques
20 (maximum likelihood estimation or MLE) to estimate Beta, Eta and to calculate the predicted AFR
21 *from actual test data for all ST3000DM001 products.* (See Section IV.B below.) **Seagate did not**
22 **select or assume Beta.** Thus, in this regard, Hospodor’s criticism of Seagate’s methodology is
23 baseless.

⁵ As explained below, any attempt to reference higher AFRs simply misreads the documents an improperly uses AFRs that do not reflect the drives shipped to consumers. (Section VI.B.)

27 ⁶ Beta is a reference to the “shape” parameter of the Weibull distribution, which is a
28 mathematical function or distribution that is used to model the probability of product failures over
time in use (or ‘age’ of the products). As explained below, the Weibull distribution has at least two
parameters, Eta, the characteristic life or scale parameter, and Beta the shape parameter.

1 19. Furthermore, H ospodor's claim rests on three alleged pieces of evidence: (1) an
 2 alleged sequence of three AFRs from different test populations of Grenada Classic drives; (2) a
 3 powerpoint presentation by Seagate employee Andrei Khurshudov; (3) a test report document for
 4 the Grenada BP2 drives. None of these pieces of evidence support his assertion that Seagate should
 5 have used a Beta value of greater than 1 to calculate the predicted AFR for the Grenada drives.
 6 H ospodor's analysis of the first piece of purported evidence is based on misrepresenting Seagate's
 7 data and misapplying Weibull analysis to that data. (Section VII.C.1, below.) H ospodor's attempt
 8 to rely on Khurshudov's powerpoint fails for many reasons, including that Khurshudov testified his
 9 conclusions did not apply desktop products like Grenada (and in fact, his report showed **Beta**
 10 **consistently less than 1 for such products**), and Khurshudov makes unfounded if not incorrect
 11 conclusions about the value of Beta that H ospodor adopts. (Section VII.C.2, below.) H ospodor's
 12 claims regarding the third piece of evidence are based on an unfounded (and unsound) interpretation
 13 of a Seagate document. (Section VII.C.3, below.)

14 20. Most importantly, perhaps, H ospodor's criticism makes absolutely no sense. It rests
 15 on the entirely false assumption that because Seagate used a Beta < 1, Seagate **underestimated** the
 16 "true" AFR of the drives, **and if** Seagate had instead used a Beta > 1, Seagate's calculations would
 17 show a higher predicted AFR. This is not accurate. **Using Beta > 1 will result in a lower**
 18 **projected AFR for any given test population**, especially for the first year, as shown in Figure 1
 19 below. This graph has different values of Eta (the characteristic life or scale parameter) along the
 20 bottom, x-axis, and AFR along the vertical, y-axis. The graph shows that the line for Beta = 0.5
 21 (light blue line) is always above the other lines—corresponding to the highest AFRs for any given
 22 value of Eta. The lines for Beta = 1.0, 1.5 and 2.0 correspond to **progressively lower** AFRs. In
 23 other words, if Seagate had assumed a Beta value greater than 1, as H ospodor insists Seagate should
 24 have done, this would have **lowered** the predicted AFR that Seagate reported in the documents he
 25 cites. (See also Section VII.B.)

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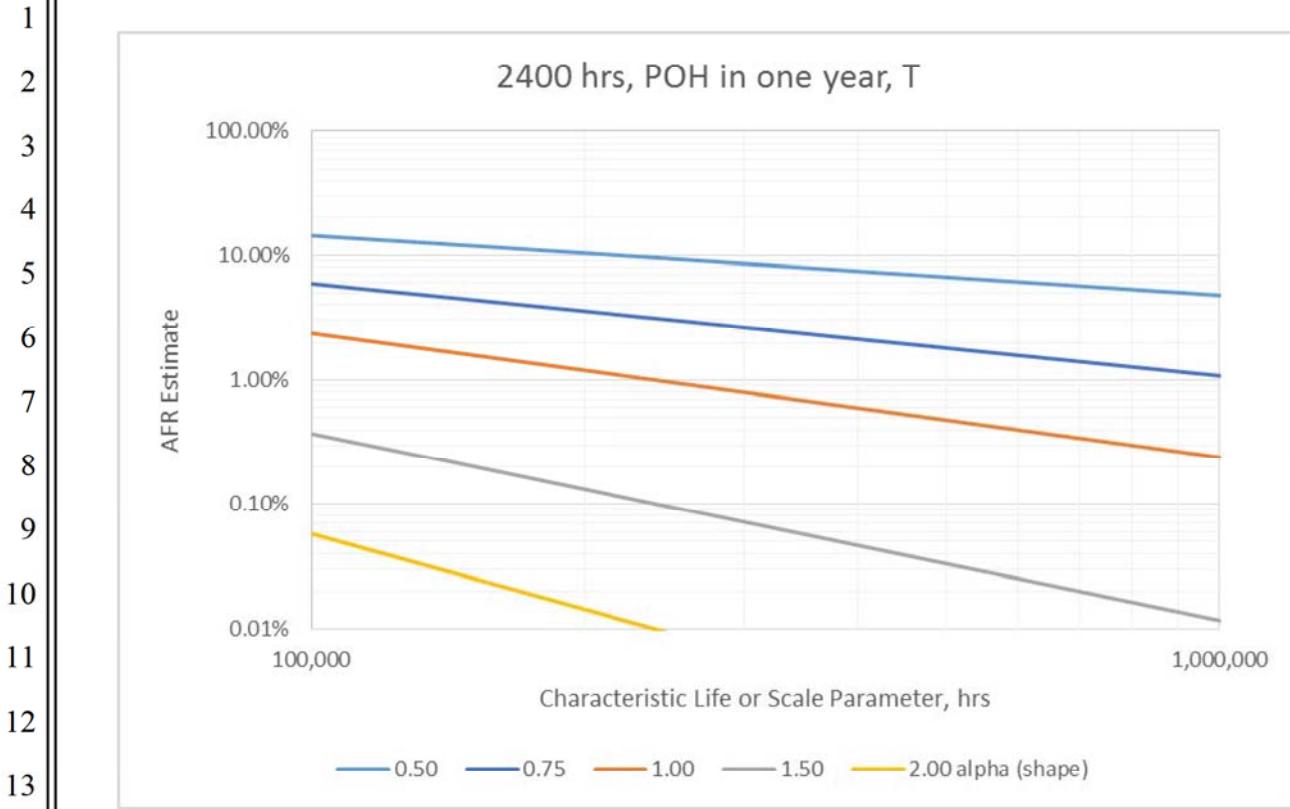


Figure 1. First year AFR using the Weibull distribution for different scale and shape parameters. (Figure prepared using Excel and Excel's Weibull function.)

C. H ospodor fails to support any conclusion that Seagate's internal, desktop ST3000DM001 products had an AFR above 1% across the class period and across different versions of the ST3000DM001 (Grenada Classic, Grenada BP and Grenada BP2), or that the drives had any problem common throughout the class period (2011-2016), or common to the products and drive versions at issue.

21. I have been asked to evaluate whether H ospodor's evidence demonstrates that internal (Disty) drives had an AFR above 1% throughout the class period (which H ospodor defines as from the release of the Grenada drives (2011) to February, 2016) or across different versions of the drives (Grenada Classic, Grenada BP, Grenada BP2). H ospodor does not provide any such evidence. The evidence shows that at the time of release of each version of the drive for use as internal (Disty) products, Seagate had tested a large population of drives and appropriately calculated AFRs below 1% for each of the Grenada Classic, Grenada BP, Grenada BP2 versions of the drives. (Figure 2 and Section VI.B.).)

22. H ospodor cites only two categories of documents that could show higher than 1% AFRs. First, H ospodor cites documents concerning Grenada Classic and BP drives used in external,

1 USB (SBS) products. However, Seagate did not advertise an AFR for these products, and so these
 2 documents do not support his conclusions.⁷ Second, Hospodor points to two documents apparently
 3 showing two periods in 2012 when testing (for less than the full 6 weeks) produced projected AFRs
 4 of above 1% for the Grenada *Classic* drives. (Section VI.C below.) However, at the time of these
 5 documents, the drives were subject to “ship holds” and not being shipped to consumers, so the
 6 documents do not show that drives shipped to consumers had a projected AFR above 1%. (*Ibid.*)
 7 Moreover, this evidence is *limited* to the Grenada *Classic* drive *in 2012*. (*Ibid.*)

8 23. None of the other evidence Hospodor cites (yields, ECRs, etc.) can be used to
 9 determine whether AFR was above 1%. (Paragraphs 83, 89, 97, 103, Netel Decl., ¶¶ 28-39.) At any
 10 rate, with one exception, Hospodor’s other evidence is limited to Grenada Classic drives in 2011-
 11 2012. Thus:

- 12 • Hospodor’s yield discussion is limited to Grenada Classic in 2011 and 2012. (Paragraph 84
 13 below.) To the extent Hospodor discusses Grenada BP, the data consists of *pre-release* yield
 14 information for Grenada BP in 2012. (*Id.*)
- 15 • Hospodor’s analysis of ECRs is based on Grenada Classic ECRs in 2011 and 2012.
 16 (Paragraphs 90 below.) Although Hospodor claims there were a high number of ECRs for
 17 Grenada BP, he fails to provide supporting evidence or analysis. (*Ibid.*)
- 18 • The ship holds Hospodor cites are from 2011-2012, and with one exception, relate to
 19 Grenada Classic. (Paragraphs 103 below.)
- 20 • The Backblaze blog posts should not be credited, but even if they were, Backblaze purchased
 21 over 80% of its drives before September 2012, so Backblaze’s blog posts do not shed light
 22 on drives manufactured after 2012. (Section VII.D below.)

23 The one exception appears to be the Apple recall, but even this was related to products
 24 manufactured before May 2013 and drives sold to OEMs such as Apple are not at issue in this case.
 25 Among other things, the Apple use environment is not evidence of how the drives performed in
 26 other environments. (Paragraph 106 below.)

27 ⁷ Even as to this evidence, it would only apply to the Grenada Classic and BP SBS drives
 28 for *relatively short periods of time* before the qualification of the corresponding Grenada Classic
 and BP Disty drives. Seagate did not maintain different manufacturing lines for SBS as opposed to
 Disty/OEM drives. (Dewey Decl., ¶ 8.) Once Seagate qualified the Disty/OEM drives any
 reliability improvements observed for those drives would apply equally to SBS drives unless there
 were some special circumstance preventing such application. But Hospodor does not cite any
 documents showing that AFR of SBS products was higher than the AFR of Disty products after the
 release of the Disty products.

1 24. Finally, as Hspodor admits, he does not identify any problem common throughout
 2 the class period (2011-2016), or common to the products and drive versions at issue (Classic, BP,
 3 BP2). (Ex. 11 [Hspodor Depo.] at 49:7-50:3; 50:23-51:3; 52:7-25.) Hspodor's references to
 4 "head related" and "contamination" "issues" are not technically sound, lacks evidence, and are
 5 irrelevant. (See Section IX.) If anything, Hspodor's comments about these "issues" suggest he
 6 does not understand modern hard drive operation or failure modes.

7 **D. Hspodor fails to support the claim that Seagate's reliability testing and quality
 8 control process were flawed.**

9 25. I have examined Seagate's Product Life Cycle Process Drive Development Overview
 10 and various program review summaries. (FED_SEAG0027285, Exhibits 1-4; *see also*, e.g.,
 11 Hspodor Figure 1.) I found them to be consistent with my experience and industry practice in the
 12 computer and HDD business. Seagate has also maintained ISO 9000 certifications continuously
 13 since 1996 or earlier. (See Section IV.E.) Hspodor argues that Seagate's reliability testing
 14 processes were flawed because Seagate did not use a Beta of greater than 1, or did not test the drives
 15 for longer than 6 weeks. These claims are not supported by evidence nor by valid methodology, as
 16 explained below. (Section VII.) Hspodor also appears to claim that Seagate's quality control
 17 processes were flawed because the number of engineering change requests ("ECRs") and firmware
 18 releases was 'too high' (in Hspodor's opinion), or Seagate's yield was 'too low' (in Hspodor's
 19 opinion). As explained below, these opinions rest on misreading or misrepresentations of Seagate's
 20 documents, and Hspodor's apparent lack of understanding of current HDD design and
 21 manufacturing methods. (Sections VIII.A, VIII.B.)

22 **E. Hspodor does not justify the claim that the ST3000DM001 drives (Grenada
 23 Classic, BP and BP2) were released for production before the design and
 24 manufacturing process were properly qualified to meet product and business
 25 goals, and unreasonably concludes the ST3000DM001 was inherently 'unstable'
 26 and 'unreliable'.**

27 26. As noted above, Seagate's test data and documents do not support Hspodor's
 28 conclusion that the drives had a higher than advertised AFR or were released early. Lacking any
 further support from actual AFR data, Hspodor turns to analyzing other aspects of Seagate's drive
 development process and claiming they show that the Grenada drives were released for production

1 before the design and manufacturing process were properly qualified, or that the drives were
 2 “unstable” or “unreliable.” Hospodor looks at yields, engineering change requests (“ECRs”), ship
 3 holds, and information about an Apple recall, and claims they show the drives were “unstable,”
 4 “unreliable,” or that the drives were released before being properly qualified.

5 27. It is important to note that none of Hospodor's claimed evidence (yield, ECRs, ship
 6 holds, Apple recall) show that any drives sold to the public had an AFR over 1%. (Paragraphs 83,
 7 89, 97, 103, 106, Netel Decl., ¶¶ 28-39.) As Hospodor admitted, these types of evidence cannot be
 8 used to determine the AFR for hard drives. Thus, these purported additional pieces of evidence do
 9 not support Hospodor's conclusions that the drives sold to consumers had an AFR that was “greater
 10 than advertised” or greater than 1%.

11 28. Furthermore, Hospodor relies on evidence regarding yield, ECRs and firmware
 12 revisions does not support his conclusions that the drives were released prematurely or that they
 13 were unstable or unreliable. For example, Hospodor claims the number of ECRs shows that the
 14 drives were unstable and released prematurely. Yet he offers no comparison by which to judge this
 15 conclusion. In my experience the number of ECRs needed to develop and release a new product is
 16 typically large, especially for a new capacity point or increased areal density. (Paragraph 94 below.)
 17 The ST3000DM001 was one of the first, if not the first, consumer desktop HDD to reach 1 TB/disk
 18 areal density. It certainly was Seagate's first such product. Furthermore, in my experience with
 19 modern drive development processes, it is not uncommon to qualify suppliers and sources after
 20 initial release and during the ramp of production of a product. (*Id.*) Thus, there is nothing
 21 noteworthy about the number or timing of the ECRs for the Grenada drives. (*Id.*) At best,
 22 Hospodor's opinions are based on very outdated drive manufacturing processes, and lower volume
 23 manufacturing with less complex supply chains. (*Id.*) The evidence Hospodor relies on regarding
 24 yield and firmware revisions does not support his opinions. (Sections VIII.A, VIII.C below.)

25 29. Similarly, Hospodor's purported evidence regarding ship holds and returns also does
 26 not support Hospodor's conclusions that consumer drives were released prematurely or that they
 27 were unstable or unreliable. Among other things, the ship holds Hospodor cites are from 2011-
 28 2012, and with one exception, relate only to Grenada Classic—they cannot support any conclusions

1 about Grenada BP or Grenada BP2 drives or drives manufactured at any later point in time.
 2 (Paragraph 103 below.) Furthermore, H ospodor's discussion of ship holds is logically flawed.
 3 Seagate issued ship holds whenever it detected a possible problem to prevent drives from reaching
 4 consumers before they were ready. Ship holds are not evidence that flawed or high AFR drives
 5 reached consumers; they are the opposite. (Paragraph 104 below.)

6 **F. H ospodor's opinions are not based on sufficient data and are not the product of
 7 accepted principles of reliability analysis correctly applied to Seagate data.**

8 30. As explained in this declaration, H ospodor consistently misrepresents and
 9 misinterprets Seagate's documents. The documents themselves do not support H ospodor's
 10 conclusions. (See e.g., Sections VI, VII, IX and Paragraphs 39, 86 95, 100, 101.) Moreover,
 11 H ospodor misunderstands and misapplies accepted principles and methods of reliability analysis,
 12 and advocates approaches that are unreliable and completely unsupported. (See Section VII.)
 13 H ospodor also applies norms of hard drive manufacturing that are several decades out-of-date. .
 14 (See Paragraphs 86 94.) There is not a single section of H ospodor's declaration that does not exhibit
 15 one or more of these problems. None of H ospodor's opinions are supported by sufficient actual
 16 data, and none result from applying reliable or accepted methods or principles to actual data.

17 **IV. Reliability Testing, AFR, and Seagate's Drive Development Process**

18 **A. Data from Reliability Testing Is Used to Estimate the Weibull Distribution
 19 Parameters and Calculate Projected AFR (and MTBF)**

20 31. AFR is commonly called Annualized Failure Rate and is a measure of reliability
 21 widely used in the hard disk drive ("HDD") industry. As such it is a probability of failure for a
 22 population in any given year, and should not be confused with instantaneous failure rate (or formally
 23 hazard function). The latter is a conditional probability of failure given survival to a specific time
 24 with units of #failures/sec. AFR is unitless and typically expressed as a percent.

25 32. AFR is typically calculated in the following manner. A sample population of hard
 26 drives is subjected to "accelerated" testing (which Seagate called reliability demonstration testing or
 27 "RDT"). This means the drives are operated at high stress (high workloads and high temperature) to
 28 produce physical failures. The high stress "accelerates" the physical failures so that the testing
 produces in a short amount of time the same failures that would happen during normal use over a

1 longer amount of time.⁸ The data obtained from this testing includes the time-to-failure of the
 2 drives that failed, and the amount of time in testing for the drives that did not fail.

3 33. In my experience, typical reliability testing involves testing about 1,000 HDDs for
 4 1,000 hours or more. Seagate's RDT involved testing approximately 1,000 drives for at least six
 5 weeks or 1,008 hours, at maximum workload. (*See* Ex. 4 [FED_SEAG0026751] (1068 drives for
 6 1009 hours); Ex. 5 [FED_SEAG0057277] at 57324 (1058 drives tested for 1197 hours); Almgren
 7 Decl., ¶ 6.) In testing the drives at maximum workload for six weeks Seagate subjected the drives to
 8 the equivalent of between **3 to 3.8 years of use** during testing. (*Ibid.*) Since Seagate also subjected
 9 the drives to high temperatures during RDT, (15-20° C hotter than the typical field applications),
 10 this would further accelerate wear on the drives, and increase the coverage of the test to 3-4 years or
 11 more of typical wear. As explained further below, Seagate used the same testing protocol for post-
 12 release, ongoing reliability testing ("ORT"). (Netel Decl., ¶ 13, 14; Paragraph 48, below.)

13 34. A distribution (or function) is then used to model the failure information (or "life
 14 data") obtained from RDT testing and to calculate a predicted MTBF and AFR as described further
 15 below. The goal of fitting a distribution is to create a model of failure rates or probabilities as a
 16 function of the time that the products are used (the age/life of the products). The two parameter
 17 Weibull function is the most common probability distribution function (pdf) used for reliability in
 18 my experience for HDDs.⁹ In fact, reliability analysis is often called Weibull analysis because this
 19 model is so popular for describing failure behavior. It is very flexible and empirically successful in
 20 fitting life data with different types of failure rate behavior, including the three failure patterns
 21 (higher 'early life' failures with decreasing failures over time, constant or random failures, and end
 22

23
 24

⁸ *See, e.g.*, National Institute of Standards and Technology ("NIST")/SEMATECH e-
 25 Handbook of Statistical Methods (herein after "NIST Handbook"),
<http://www.itl.nist.gov/div898/handbook/>, 10/30/2013; section 8.1.4 "What is "physical
 26 acceleration" and how do we model it?" at
<http://www.itl.nist.gov/div898/handbook/apr/section1/apr14.htm>.

27 ⁹ *See* NIST Handbook, Section 8, "Assessing Product Reliability" at
<http://www.itl.nist.gov/div898/handbook/apr/apr.htm>; "Life Data Analysis Reference" produced by
 28 ReliaSoft Corporation in Tucson, Az., 5/22/2015, <http://www.ReliaSoft.com>; "An Introduction to
 Applied Probability", Ian F. Blake, 1979; Chapter 12, "Reliability Theory," page 357.

1 of life or wear out) that comprise the so called ‘bathtub curve.’¹⁰

2 35. The Weibull function has at least two parameters, the “scale” or “characteristic life”
 3 parameter Eta (η) and the “shape” parameter Beta (β).¹¹ The scale parameter, Eta, defines where the
 4 bulk of the distribution lies, while the shape parameter Beta describes the general shape of the
 5 distribution. In general, a Beta of less than 1 (<1) means that the failure rate is decreasing with the
 6 age or time in use of the products, a Beta of 1 means that the failure rate is constant over age (time
 7 in use), and a Beta of greater than 1 (>1) means the failure rate is increasing with age (time in use).
 8 There is an analogy to human populations, where Beta could be thought of as describing whether the
 9 probability (or rate) of deaths increases or decreases **as a population ages**. (e.g., Does the
 10 population have high infant mortality with decreasing probability of death after infancy? Or do 40
 11 year-olds have a higher probability of dying than 10 year-olds?) In the human context, Beta > 1
 12 would describe an increasing probability of death **with age**. Beta > 1 would describe, e.g., a situation
 13 in which 40 year-olds have a higher chance of dying than 10 year-olds. The “AFR” would be the
 14 annualized probability of dying **at any given age**.

15 36. However, Beta does not control the actual value of the AFR—one could have an
 16 AFR of 0.01% or 20% and a Beta > 1 or equal to 1 or < 1 . Furthermore, as explained in paragraph 20
 17 above, and as shown in Figure 1, a Beta < 1 will result in a higher projected AFR for any given
 18 characteristic life (Eta), especially for the first year.

19 37. By contrast, the characteristic life or scale parameter is just as important to
 20 determining AFR, and cannot be ignored as Hospodor does. Among other things, the Weibull
 21 distribution has two parameters and both are necessary to calculate the predicted AFR. One can’t
 22 just ignore “half the equation” (so to speak) as Hospodor does. Furthermore, Eta has an important
 23 impact on the resulting AFR. As shown in Figure 1, for a Beta value of 0.75, a 10x increase in the
 24 characteristic life (from 100,000 hours to 1 million hours), results in approximately a *10x decrease*
 25 in AFR. (See Figure 1, dark blue line. The vertical, or y-axis is on a log scale.) For a Beta value of
 26

27 ¹⁰ See NIST Handbook, section 8.1.2.4 “‘Bathtub’ curve” at
 28 <http://www.itl.nist.gov/div898/handbook/apr/section1/apr124.htm>; chapter 8.1.6.2., “Weibull” at
<http://www.itl.nist.gov/div898/handbook/apr/section1/apr162.htm>.

¹¹ See e.g., <http://www.weibull.com/basics/parameters.htm>.

1 >1, the effect of changes to Eta are even more dramatic. (Additionally, more improvement of the
 2 characteristic life (Eta) is needed to achieve an AFR target when the shape parameter is lower, <1.)
 3 The effect is similar when looking at total failure probabilities (FR) over 5 years.

4 **B. Seagate Always Estimated the Weibull Parameters and Calculated the Projected
 5 AFR for the Grenada Drives from Actual Test Data – It Did Not “Assume” Beta**

6 38. In paragraph 38, H ospodor says: “Data obtained during testing is used to calculate
 7 the beta parameter of the Weibull distribution, and the beta is then used in projecting AFR.”
 8 However, in other parts of his declaration H ospodor repeatedly claims or assumes that Seagate
 9 selected, used a pre-selected or ‘assumed’ a Beta <1 when Seagate was calculating AFRs.
 10 (H ospodor claims this was inappropriate, that it resulted in Seagate underestimating the ‘true’ AFR,
 11 and that Seagate should have used a Beta > 1.) As explained below, each part of H ospodor’s
 12 reasoning is flawed. Seagate did not ‘select’ or ‘assume’ a Beta of <1 for the Grenada drives. In
 13 fact, Seagate always used reliability test data to estimate both the characteristic life, Eta, and shape
 14 parameter, Beta, for use in the Weibull distribution and calculating AFR. (See Almgren Decl., ¶ 8-
 15 10; Ex. 13 [Almgren Depo.] at 182:8-183:10, 185:4-186:6; Netel Decl., ¶ 18.)

16 39. Indeed, it is apparent from the Seagate documents H ospodor cites that Seagate
 17 always used MLE to estimate Beta (and calculate projected AFR values) from actual reliability
 18 testing on Grenada drives. The Seagate documents state that the AFR is “From all fails Weibull
 19 MLE”—clearly indicating that the AFR is obtained from maximum likelihood estimation (MLE) on
 20 the failures that occurred during actual testing. (Ex. 1 [FED_SEAG0026697] at 26704, Ex. 2
 21 [FED_SEAG0026839] at 26844; Ex. 3 [FED_SEAG0026867] at 26887; Ex. 4
 22 [FED_SEAG0026751] at 26783; Ex. 5 [FED_SEAG0057277] at 57324.) Furthermore, the number
 23 of drives tested and time in testing is listed in each document. (*Ibid.*) The Beta value is given and it
 24 varies from test to test (from document to document) and is often expressed out to 6 or 7 places past
 25 the decimal point. (*Ibid.*) All of these factors are obvious indications that Seagate calculated the
 26 predicted AFR (and Beta) using MLE based on actual test data from Grenada drives.¹² The Beta,
 27 and AFR values Seagate calculated, and the corresponding test population are shown in Figure 2

28 ¹² In each case, Seagate confirmed that the Beta value was less than 1 based on the actual
 test data. (*Ibid.*)

1 below. Furthermore, at least one of Seagate's employees testified that that Seagate determined AFR
 2 and Beta from actual test data. (Ex. 13 [Almgren Depo.] at 182:8-183:10, 185:4-186:6.) Given
 3 these facts, Hospodor's repeated insistence that Seagate 'assumed' or 'selected' Beta of less than 1
 4 is inexplicable and demonstrably wrong.

Exhibit, page	Drive / Product	Test Date	# of drives tested	Av Hrs tested	Beta	Demo'd MTBF	Demo'd Reduced AFR	Raw AFR
Ex. 1 at 26704	Grenada Classic / SBS	4/27/11	1651	740	0.608098	101,000	2.340%	7.006%
Ex. 2 at 26844	Grenada Classic / Disty	10/17/11	1360	953	0.63955018	251,000	0.950%	2.621%
Ex. 4 at 26785	Grenada Classic / Disty (ORT Testing)	6/4/12	N/A	535	0.506781	100,000	2.350%	3.436%
Ex. 3 at 26887	Grenada BP / SBS	4/12/12	1068	661	0.4819208	118,000	2.000%	2.942%
Ex. 4 at 26783	Grenada BP / Disty	5/14/12	1068	1009	0.4756772	243,000	0.980%	2.917%
Ex. 5 at 57324	Grenada BP2 / Disty	1/14/14	1058	1197	0.394	267,000	0.90%	1.039%

17 **Figure 2** Results of Seagate reliability testing cited by Hospodor. Results for internal, desktop
 18 (Disty) releases are in blue text. The first 3 lines concern Grenada Classic drives, the next two
 19 concern Grenada BP drives and the last Grenada BP2. All AFR estimates use an assumed 2400
 20 POH/year (the only assumption). (Ex. 1 [FED_SEAG0026697] at 26704, Ex. 2
 21 [FED_SEAG0026839] at 26844; Ex. 3 [FED_SEAG0026867] at 26887; Ex. 4
 22 [FED_SEAG0026751] at 26783, 26785; Ex. 5 [FED_SEAG0057277] at 57324.)

23 40. In paragraph 38, Hospodor also claims that "[a]s discussed in more detail in Section
 24 H, the Weibull beta calculated by Seagate did not match the true failure characteristics of the
 25 ST3000DM001, which demonstrates that Seagate's testing was flawed and underestimated the true
 26 AFR of the Drive." As explained further below, Hospodor provides no evidence in his Paragraph 38
 27 or later in his Section H for his claim that "Seagate's testing was flawed and underestimated the true
 28 AFR of the Drive." Furthermore, Seagate used industry-standard software and well-established
 maximum likelihood estimation (MLE) methods to obtain the Weibull parameters from actual test

1 data on the drives. In this sense, Seagate's estimated Beta and Eta parameters, (and AFRs) do and
 2 must reflect the failure characteristics for the ST3000DM001 drives.

3 **C. Hospodor Makes Several Misstatements about AFR and MTBF in His Sections
 4 IV.C.1 and IV.C.2.**

5 41. Hospodor's description of AFR and MTBF contain a few notable errors. Together
 6 with errors elsewhere in his report and in his deposition, it does not appear that Hospodor fully
 7 understands reliability analysis, and in particular does not understand the Weibull analysis or the
 8 significance of the parameters Beta and Eta:

9 a. As explained above, both Eta and Beta are required along with the assumed
 10 number of POH per year to project an AFR. Throughout his declaration, Hospodor
 11 consistently ignores Eta, which is improper.

12 b. In Paragraph 27, Hospodor claims that "common" failure modes for "the
 13 ST3000DM001" were "contamination and head-related failures" and *implies* (but does not
 14 claim) that these failure modes are not "independent" and *implies* (but does not claim) that
 15 because of this, it was improper for Seagate to use the Weibull distribution to project AFR.
 16 Statistical independence is important to the estimation of life parameters for the Weibull
 17 distribution. But multiple failure modes does not imply dependence of failure times, and
 18 Hospodor provides no basis for believing that the failure modes he discusses are statistically
 19 dependent. In particular, *Hospodor cites no evidence* or reason to believe that different
 20 contamination-related failures, or different head-related failures, are causally related or
 21 statistically dependent. Accordingly, Hospodor's discussion of "contamination" and "head
 22 related" failures does not support any conclusion that Seagate improperly utilized the
 23 Weibull distribution to estimate AFR. Rather, as discussed in Section IX below, his repeated
 24 references to "head related" failures and "contamination" issues do not point to any sort of
 25 common problems or issues because "head related" and "contamination related" failures are
 26 broad categories, with myriad unrelated potential causes.¹³

27

 28 ¹³ Certainly the possible existence of multiple failure modes complicates the data analysis.
 But Seagate demonstrates their ability to separate them out even if they do not go so far as to
 estimate the life parameters for each. The methods for doing this are well known and there are

1 c. In Paragraph 28 H ospodor defines MTBF as “mean time between failure.”

2 Strictly speaking MTBF means Mean Time *Before* Failure as used for HDDs. (It is literally
3 the statistical mean or average time to failure over a specified time interval, zero to infinity.)
4 Mean Time Between Failure is used for systems or components that can be repaired.

5 Usually HDDs are not repaired.

6 d. As H ospodor acknowledges in Paragraph 33, the AFR is not necessarily
7 constant over the expected service life of an HDD. Elsewhere he implies that Seagate’s use
8 of the first-year AFR is improper. Historically the shape parameter for the Weibull life
9 distribution has been less than 1 for HDDs, meaning that *the first year AFR* will be *the*
10 *highest* of any of the years during the expected service life of the drive. Any advertised or
11 specified AFR value is a maximum failure probability for any year over the warranty period,
12 expected service life, or both. As explained in Section B above, with regard to the Grenada
13 drives, Seagate always projected AFR values based on estimates for Eta and Beta using data
14 from reliability testing on Grenada drives, and in each case, confirmed that the Beta value
15 was less than 1. H ospodor has provided no contrary evidence. So an emphasis on the first
16 year AFR is reasonable since it will be the maximum AFR for the relevant period.

17 D. Seagate’s Usage Estimates Were Reasonable

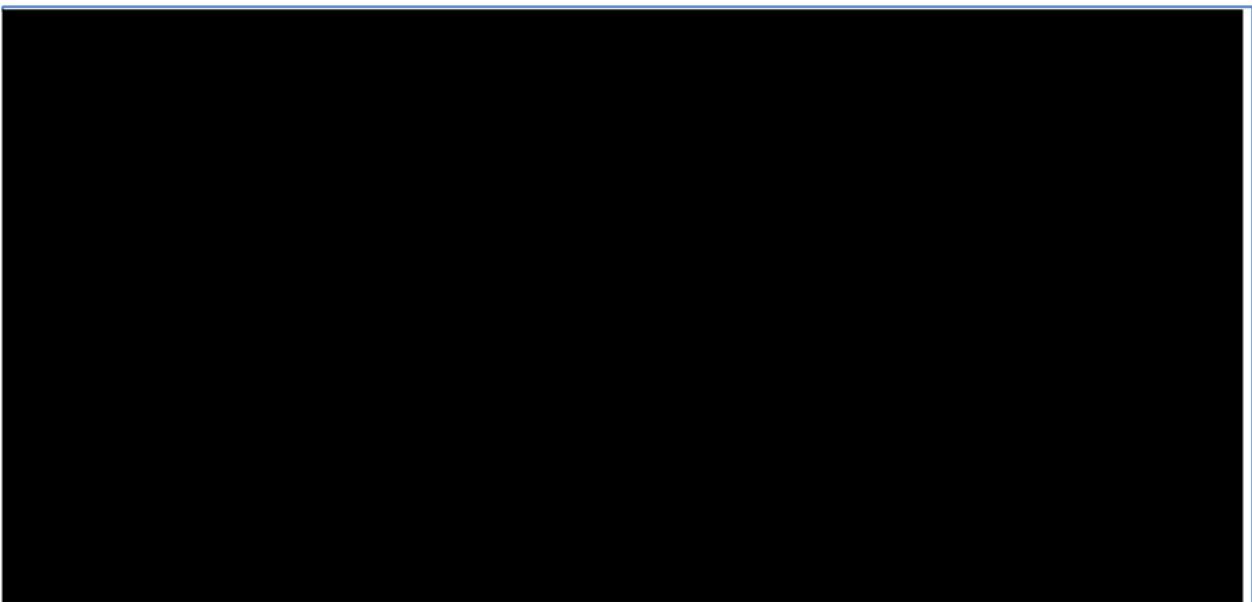
18 42. Seagate set goals for cumulative failure probabilities out to 5 years as summarized in
19 Figure 3 below which shows a table from their “Best in Class 5 year Service Life Initiative.”¹⁴
20 (FED_SEAG0056259, at p. 56262.) This table summarizes design goals for *total* failure rate or
21 probability, (“FR”), over 5 years in different kinds of applications or market segments. The MTBF
22 is the mean time before failure over that period, and does not assume any particular shape of the
23 failure distribution. In other words, one can have the same mean (or average) failure time regardless
24 of whether the failure rate starts higher and decreases with time, starts lower and increases with

25 several software tools that assist the process, including the Weibull++ and JMP software, with
26 which I am familiar, and which Seagate used.

27 ¹⁴ H ospodor cites this document several times in his Declaration, and even cites this specific
28 page. (See H ospodor Paragraph 33 footnotes 8, and Paragraph 111 and footnote 53.) Yet H ospodor
claimed in his deposition that he had never seen the document before and wouldn’t have relied on it
because it doesn’t list a single author. [CITE] This further supports my opinion that H ospodor’s
characterization and review of the evidence he cites was sloppy at best.

1 time, or stays steady for the entire period. Thus, the FR goal can also be achieved regardless of the
2 distribution shape. Hospodor does not seem to understand this principle because he repeatedly
3 implies that the *shape* of the failure rate distribution over time (Beta) determines the value of the
4 AFR, the number of failures over time, and the cumulative failure probability (the FR). Seagate's
5 former employee Andrei Khurshudov, on whom Hospodor claims to heavily rely, explained this in
6 his deposition, yet Hospodor either ignores or seems not to understand it. (See Ex. 14 [Khurshudov
7 Depo.] at 81:21-82:9, 84:7-86:8.)

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19 **Figure 3.** [REDACTED]



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22 43. The "mission time" column in the table expresses Seagate's understanding of how
23 heavily its different products would be used. This can also be expressed in the form of power-on-
24 ours ("POH") per year. In paragraph 36, Hospodor incorrectly defines power-on hours, POH, as
25 "the number of hours a year that the drive is powered on." It is correctly defined as just the number
26 of power-on hours accumulated for an HDD at any point in its life. (It is similar to the odometer in
27 a car.) And it does not indicate the workload when powered-on. The number of POH per year is the
28

1 key and only assumption that goes into an AFR estimate. The value used must be less than the
 2 number of hours in a year, 8760 ignoring leap years, and depends on the application.

3 44. As shown in Figure 3, for the SBS backup HDD, the POH per year is 730 hours/year
 4 or 3650 hours for the 5 year service life goal. Based on my experience, two hours a day is
 5 reasonable for external, backup, USB products because such products are meant for backup
 6 purposes. It would be difficult to use them for anything else, such as running a computer's
 7 operating system or acting as the primary data store for a computer. For desktop OEM and Disty
 8 HDDs Seagate assumes 2400 POH/year used in typical desktop or home applications.¹⁵ Based on
 9 my experience this is also reasonable, since most desktop computers are used by individuals and
 10 therefore not used 24 hours a day 7 days a week. Furthermore, even when a desktop computer is
 11 running, it does not continuously use the hard drive at maximum workload.

12 **E. Seagate's Drive Development and Manufacturing Process Was Appropriate and**
 13 **Consistent with Industry Standards – Including Release of Drives to SBS before**
Release to Disty

14 45. My review of the documents Hospodor cites, Seagate's ISO certifications, and the
 15 declaration and depositions of Seagate employees demonstrates that Seagate's drive development
 16 and manufacturing processes were appropriate and consistent with currently accepted industry
 17 practice and standards. This applies to both Seagate's development and drive qualification or
 18 approval process, and Seagate's post-release, ongoing reliability and quality monitoring. Among
 19 other things Seagate's drive design and manufacturing processes have been ISO-certified since
 20 1993.¹⁶ (Paneno Decl., ¶ 4.) The ISO 9001 certifications included examining Seagate's product
 21 development process, reliability testing, quality controls, supplier controls, and ship holds process.
 22 (Paneno Decl., ¶ 3.) Hospodor does not present any evidence that Seagate's processes were
 23 insufficient or flawed.

24 46. Seagate's Product Life Cycle Process is consistent with my experience since the early
 25 1990s and currently accepted industry practice in the computer and HDD business.

26

¹⁵ Moreover, Seagate also included the 2400 POH/year specification in product Data Sheets
 27 that mention the <1% AFR rating. (See Paragraph 53.)

28 ¹⁶ Copies of ISO certificates indicating certification since 1996 (for its Longmont, CO
 facility) and 1999 (for other sites) to present are available on Seagate's website at
<https://www.seagate.com/global-citizenship/iso-9001-certification/>. (Paneno Decl., ¶ 4.)

1 (FED_SEAG0027285) The process used by Seagate is consistent with the state of the art among
 2 hard drive producers.

3 47. Hospodor describes in Paragraph 42 the fact that Seagate first released a new drive to
 4 the “internal” SBS customer before later qualifying the drive for release to the Disty and OEM
 5 channels. SBS (Seagate Branded Solutions) was Seagate’s division that used the drives within
 6 external, USB products. The practice of releasing drives to internal customers first is customary in
 7 the industry and there are several reasons for it. First, the SBS teams need to complete development
 8 and qualification of the SBS products, which include not only the HDD, but a mechanical enclosure,
 9 additional electronics, software and retail packaging, and usually a power supply. All of these
 10 components need to be tested and developed with the drive, so the SBS teams need to receive drives
 11 ahead of the time that they will eventually release in the integrated products. Second, for SBS
 12 (external, USB) products, the end application of the HDD is defined—the HDDs are being put into
 13 external, USB products that Seagate builds—so that drive environment and the usage patterns of the
 14 products are well understood. The POH per year and workloads are known to be low, which
 15 requires less accumulated reliability test time to estimate an MTBF that is consistent with offered
 16 warranties and customer expectations. As explained above, the evidence I have seen shows that
 17 Seagate did not advertise an AFR for external, USB products containing the Grenada drives.
 18 Rather, Seagate required the SBS drives to meet an MTBF of 100,000 hours, which is reasonable.
 19 (See Dewey Decl., ¶ 11; Almgren Decl., ¶ 12; FED_SEAG0026697 at 26699; FED_SEAG0026867
 20 at 26870 and 26886.)) Seagate’s process for testing and qualifying SBS products meet currently
 21 accepted industry practice in this regard. By contrast, the end environments are not as well known
 22 for OEM and distribution markets. In other words, for the disty market, individual users are
 23 inserting the drives into their own desktop computers or systems, and Seagate does not control that
 24 end-use environment. Similarly, OEMs can have varied requirements and enclosures/systems. The
 25 expected POH per year and workloads are higher for disty/OEM (internal, desktop) drives. So more
 26 accumulated reliability test time is needed to make AFR predictions for them. Therefore, drives are
 27 typically released for use as internal, desktop drives later than they are released to internal
 28 customers/SBS product uses.

1 48. Finally, after drives were approved for release and put into production, Seagate
 2 monitored the quality and reliability parameters for the drives that were coming off Seagate's
 3 production lines, using ongoing reliability testing (ORT). Seagate's ORT used the same high-stress
 4 workload and temperatures protocols as Seagate's pre-release, RDT described above, except that
 5 Seagate employed ORT on a rolling population of drives sampled from the end of the manufacturing
 6 line. (Netel Decl., ¶¶ 9-19.) If the results of ORT testing exceeded any of Seagate's trigger limits,
 7 Seagate issued a ship hold or stop ship order (SSO) and stopped shipment of drives until Seagate
 8 had demonstrated that it had corrected the problem. (*Ibid.*; *see also*, e.g., Ex. 9
 9 [FED_SEAG0009670] (reporting a ship hold issued for ORT trigger).)

10 49. These practices are fully consistent with current, accepted industry norms.
 11 Moreover, Seagate has been ISO 9001 certified since well before the development of the Grenada
 12 drives, providing further evidence that Seagate's manufacturing and quality control processes meet
 13 industry standards.

14 **V. Hospodor's Claims about the "Advertised" AFR of the Drives Are Not Supported**
 15 **(Hospodor's Section IV.E)**

16 50. It is my opinion that an expert is not required to understand or interpret Seagate's
 17 website or Seagate's marketing materials, user guides, data sheets or other publications for
 18 consumers regarding the Grenada drive products. It is my understanding this is Hospodor's position
 19 as well. (Ex. 11 [Hospodor Depo.] at 315:22-317:13 ("I think that any person could look at
 20 Seagate's website and see what it says about AFR."); "I think that the product manuals and the data
 21 sheets are written to be as simplistic as possible So I would say no, they don't require a Ph.D.
 22 in computer engineering to understand them.") However, because Hospodor draws so many
 23 conclusions that depend on his assertions regarding Seagate's consumer-facing publications, I
 24 believe it is appropriate to point out that his assertions are incorrect based on the information
 25 available to me.

26 51. The evidence I have reviewed does not support Hospodor's assertion that Seagate
 27 "advertised" an AFR of 0.34% in April, 2011 when Seagate "first released" Grenada Classic drive
 28 for shipment as part of the SBS product. Hospodor cites one document that Seagate's employee

1 Karl Schweiss testifies is a draft document that was never published to consumers. (Schweiss Decl.,
 2 ¶¶ 6-7.)

3 52. The evidence I have reviewed also shows that Seagate did not publish or advertise an
 4 AFR specification for the SBS (external, USB) products. (See Dewey Decl., ¶ 17; Almgren Decl., ¶¶
 5 12, 21; Schweiss Decl., ¶ 14; Fochtman Decl., ¶¶ 7-8; Payne Decl., ¶ 14.)

6 53. The evidence I have seen indicates that Seagate, at some times, published an AFR of
 7 <1% for internal, desktop products only (e.g., the Barracuda product and Internal HDD product).
 8 (E.g., Schweiss Decl., ¶¶ 10-14; Fochtman Decl., ¶¶ 9-10; Berman Decl., Exs. 2, 3, 11, 12, 14-19.)
 9 However, the data sheets I have seen show that Seagate also specified that the <1% AFR was for
 10 2,400 POH per year. (Payne Decl., ¶ 12.) By contrast, the documents in which Seagate mentioned
 11 an 8760 POH/year number did not contain any AFR number.¹⁷ (*Id.*)

12 **VI. Hospodor Fails to Support His Claims that the ST3000DM001 Drives Had a “Higher**
than Advertised” AFR

13 54. In his Sections IV.F. and IV.G (paragraphs 59-89) of his declaration, Hospodor
 14 presents evidence he claims shows that “the Drives” had a “higher than advertised” AFR.
 15 Hospodor's opinions are based entirely on analyzing documents written and produced by Seagate.
 16 Hospodor does not claim to have performed any testing or analysis of ST3000DM001 drives, or
 17 attempted to independently determine the failure rate of any of the drives. (See e.g., Hospodor
 18 Decl., Appendix 1 (materials on which Hospodor relied); Ex. 11 [Hospodor Depo.] at 50:4-22,
 19 54:17-55:5.) Hospodor's opinions rest on misinterpreting or misrepresenting Seagate's documents,
 20 and are not supported by the evidence he cites.

21 A. **The Majority of Hospodor's Analysis Relates to SBS Products**

22 55. The bulk of Hospodor's analysis—including all of Paragraphs 61 to 79—relates
 23 solely to Seagate's testing and qualification of the Grenada Classic drives for use in a single

24 ¹⁷ Furthermore, it is my understanding that Plaintiffs' evidence shows that at most, Seagate
 25 published a “0.34%” AFR for the ST3000DM001 drives for approximately 4 months at the end of
 26 2013. (Hospodor Decl., ¶ 54 (claiming that the 0.34% specification was published from September
 27 2013 to January 2014). *See also* Fochtman Decl., ¶¶ 9-10 (explaining that when Seagate published
 28 the “0.34%, <1%” AFR Hospodor cites, it was clearly combined information for many different
 drives, and did not state that the 0.34% AFR applied to the ST3000DM001 drives); Payne Decl., ¶
 12 (at the time Hospodor claimed Seagate published the “0.34%, <1%” AFR, the Data Sheets at
 those times specified that the ST3000DM001 drive had a “<1%” AFR for 2400 POH.))

1 external, USB (SBS) product. All of these paragraphs analyze a single document, the “Grenada
 2 SBS SAD” dated 4/28/2011. (Ex. 1 [FED_SEAG0026697].) This was the approval to ship the
 3 Grenada **Classic** drive *as part of a single SBS (external, USB) product, codenamed “Rockit.”* (See
 4 Dewey Decl., ¶ 10; Ex. 1 [FED_SEAG0026697] at 26699.) Hospodor claims this document shows
 5 “Seagate knew that it was falsely advertising the failure rate of the Drive.” This cannot be true
 6 because Seagate did not publish an AFR for the SBS products. (Section V.) Accordingly,
 7 Hospodor’s extensive discussion of the Grenada SBS SAD does not support his conclusion that the
 8 AFR of the drives was “higher than advertised.”

9 56. Seagate required SBS products to have an MTBF of 100,000 hours, and Seagate
 10 demonstrated the Grenada Classic drives met this requirement at the time they were approved for
 11 this SBS release. (Ex. 1 [FED_SEAG0026697] at 26699, 26703, 26705; Dewey Decl., ¶ 11;
 12 Almgren Decl., ¶ 12.) Even so, a demonstrated 100,000 hour MTBF could reasonably result in a
 13 projected AFR <1% for external, USB products like these. Specifically, as explained above, these
 14 products were expected to have fairly low usage. Seagate estimated 2 hours/day, which is
 15 reasonable for external, USB products like these. Even assuming a power on hours of 1000
 16 hours/year (2.7 hours/day), for an MTBF of 100,000 hours this results in an AFR <1%.

17 57. In the remainder of Paragraphs 61-79, Hospodor continues to analyze the SBS SAD
 18 for the Grenada Classic drives, and draws numerous unfounded conclusions from it. I will discuss
 19 some of Hospodor’s additional claims about this document further below. (See Section IX.)

20 58. In Paragraph 83 Hospodor cites to the **SBS** ship approval document for the Grenada
 21 **BP** drives. (Ex. 3 [FED_SEAG0026867].) Hospodor claims this document shows “testing
 22 conducted on April 12, 2012 revealed a first-year AFR of 2.942% and a ‘demonstrated reduced AFR’
 23 of 2.0%.” However, this was the approval for shipping the Grenada BP *as part of external, USB*
 24 **(SBS) products.** (Dewey Decl., ¶ 17.) Since Seagate did not publish an AFR for external, USB
 25 products this document cannot support Hospodor’s claim that the AFR was “higher than
 26 advertised.” As noted, for use in SBS products, Seagate required the drives to show an MTBF of
 27 100,000 hours. In this case, Seagate tested 1068 drives for an average of 661 hours and
 28 demonstrated an MTBF of 118,000 hours. (Ex. 3 [FED_SEAG0026867] at 26887.) Once again,

1 Seagate clearly utilized MLE on the actual failure data from this testing to estimate the Weibull
 2 parameters (including Beta) and to calculate the projected MTBF (and AFR). Since Seagate did not
 3 publish an AFR for these products, H ospodor's claim that "the 'potential reduced AFR' was also well
 4 in excess of the advertised failure rate" is unfounded.

5 **B. H ospodor's Claims Regarding Grenada Drives Used in Internal (Disty)
 6 Products Are Not Supported by the Document He Cites**

7 59. Beginning in paragraph 80 through 81 H ospodor refers to the test results table for
 8 reliability testing and analysis in the "Grenada SAD Approval 10/18/11" which was the approval to
 9 ship the Grenada Classic drives as internal, desktop drives (the OEM and Disty products). (Ex. 2
 10 [FED_SEAG0026839].) *This document shows that the drives had a "Demo'd Reduced AFR"*
 11 *(demonstrated reduced AFR) of 0.95%* at the time they were approved for sale as internal drives.
 12 "Demo'd Reduced AFR" meant that Seagate had *demonstrated* the efficacy of listed corrective
 13 actions, which reduced the AFR of the drives to the value stated in the "demo'd reduced" number.
 14 In other words, the demonstrated reduced AFR is the relevant AFR value because it reflects the
 15 demonstrated results of changes in place at the time the drives were approved.¹⁸ (Almgren Decl.,
 16 ¶ 18; Ex. 13 [Almgren Depo.] at 143:20-145:5, 162:2-18; Dewey Decl., ¶ 15.) The raw AFR
 17 H ospodor cites (2.621%) **is not** the AFR for drives shipped to customers because it does not reflect
 18 changes Seagate had already made (and demonstrated were effective at reducing the AFR).
 19 Furthermore the Demo'd reduced AFR of 0.95% met Seagate's internal requirements and comported
 20 with the published AFR of 1%. The document makes clear that this projected AFR was calculated
 21 using MLE on the results of testing 1,360 drives for an average of 953 hours.

22 60. In Paragraph 81, he goes on to incorrectly claim that "Seagate's own internal testing
 23 of the Drive revealed an increasing, not decreasing, AFR. AFR typically increases when drives
 24 begin to wear out as they approach the end of their design life. Early wear out is a hallmark of
 25 unreliable products, and are often due to flaws in the design or components." None of these
 26 statements make sense. The actual relevant sequence of demonstrated AFR projections at this time

27 ¹⁸ It is customary to revise AFR predictions in the course of development as root-cause for
 28 test failures are found and corrective action confirmed. Seagate conservatively called this the
 'Demo'd Reduced AFR.' It is standard practice that all corrective action listed must be in place to
 start volume production thereafter.

1 was 2.34% at SBS SAD on 4/28/2011 (with 740 hours on average per unit) and 0.95% at
 2 Disty/OEM SAD on 10/18/2017 (with 953 hours). This is *not* an “increasing” AFR. (*See also*
 3 Figure 2 *supra*. (the raw AFR also decreased).) Furthermore, in both cases, the estimated Weibull
 4 Beta or shape value was less than 1. In fact it was 0.63955018 for the Disty/OEM SAD. This means
 5 that the projected first year AFR would be the highest for any year during the service life, and would
 6 decrease in subsequent years of use. Any claims that the AFR was ‘increasing’ are completely
 7 unsupported. Furthermore, Hospodor’s statements about “wear out” are incoherent and jumble
 8 meaningless statements about “wear out” at the end of a product’s design life, with its opposite,
 9 “early wear out.” (*See also* Almgren Decl., ¶ 18.)

10 61. In Footnote 38 Hospodor references the “Grenada BP ECQ Approved Final” on
 11 5/5/2012 (30). (Ex. 4 [FED_SEAG0026751].) This document approved the general release of the
 12 Grenada **BP** drives as internal (Disty) drives. Hospodor claims this document shows that the AFR
 13 for “the Drive” “remained” higher “than advertised.”¹⁹ This is not the case. This document shows
 14 that the relevant AFR (the ‘Demo’d Reduced AFR’) of the Grenada BP drive was 0.98%, based on
 15 testing 1068 drives for an average test time of 1009 hours. (Dewey Decl., ¶ 18; Almgren Decl., ¶
 16 22.) This comports with released and published documentation for internal, desktop products (the
 17 Barracuda and Desktop HDD products) and it met Seagate’s internal requirements. As with other
 18 AFRs, Seagate clearly utilized MLE on the actual failure data to estimate the Weibull parameters
 19 (including Beta) and to calculate the projected MTBF (and AFR). Importantly, the first year AFR
 20 was not 2.917% as Hospodor claims. Hospodor quotes the raw AFR, before the changes Seagate
 21 made to achieve the demonstrated reduced AFR. As explained, the raw AFR does not represent
 22 drives shipped to consumers, because it does not include the changes Seagate implemented.

23 62. Finally, Exhibit 5 [FED_SEAG0057277] contains the approval for general release of
 24 the Grenada **BP2** drives to SBS and Disty/OEM on January 15, 2014. This document shows that the

25
 26 ¹⁹ In addition, *the Grenada BP was a new version of the ST3000DM001 drive with*
 27 *significant changes*. (Dewey Decl., ¶ 6; Ex. 11 [Hospodor Depo.] at 191:23-192:18.) Thus, it was
 28 required to go through new RDT testing before being approved for release. In other words, the
 document containing the approval for the initial release of the Grenada BP drive as an internal
 (Disty) drive, concerns a new release, not post-release testing on a previously released drive as
 Hospodor implies.

1 relevant AFR (the ‘Demo’d Reduced AFR’) of the Grenada BP2 drive was 0.9%, based on testing
 2 1058 drives for an average test time of 1197 hours. (Almgren Decl., ¶ 29 and fn. 5; Ex. 5
 3 [FED_SEAG0057277] at 57324; *See also* Paragraph 78 below.)

4 **C. Only Two Documents Contain AFRs above 1% for Internal (Disty) Drives, but
 5 the Drives at Issue Did Not Reach Consumers**

6 63. Hospodor cites only two documents containing AFRs over 1% for internal (Disty)
 7 drives. Both relate to Grenada *Classic* drives *in 2012* that were not being shipped to consumers at
 8 the time. Hospodor cites no evidence that Grenada BP or Grenada BP2 drives had AFRs over 1%.
 9 First, in Paragraphs 84 and 85, Hospodor references the Ongoing Reliability Testing (“ORT”) for
 10 Grenada *Classic* drives *in June 2012*. At this time, the Demo’d AFR projection is 2.35%, which is
 11 above the 1% target for this test and the Classic drive vintage.

12 64. However, the single most important factor to consider is that the Grenada Classic was
 13 under a ship hold at the time, *so the drives in question were not being shipped to consumers*.
 14 (Netel Decl., ¶21.) Hospodor himself cites a document demonstrating that the Grenada Classic
 15 drives were under a ship hold at this time. (Ex. 7 [FED_SEAG0008927 reproduced as
 16 FED_SEAG0054950].) Hospodor does not cite any evidence that internal (Disty) drives referenced
 17 in this document were shipped to consumers. Furthermore even though this Grenada Classic ORT
 18 estimate is high, it is not excessive or indicating some sort of epidemic. The Demo’d Reduced
 19 failure rate of 2.35% is certainly not “ten times” higher than the published AFR of 1%.

20 65. Hospodor cites only one other document as containing an AFR above 1% for internal
 21 (Disty) drives. In his Paragraph 177 and Figure 26, Hospodor cites Exhibit 9 [FED_SEAG0009670]
 22 as showing an AFR above 1% for the Grenada *Classic* drives for a few weeks in *early 2012*. (The
 23 document is dated February 7, 2012.) However this document reports that Seagate issued a ship
 24 hold on the drives because they were over the 1% AFR trigger. Seagate was not shipping these
 25 drives to consumers either. **Hospodor does not present any evidence that internal Grenada**
 26 **drives with AFRs above 1% were ever shipped to consumers**, much less that any such practice
 27 existed across different products or over time.

28 66. Furthermore, the AFR numbers reported in the two documents cited above “raw,”

1 pre-fix numbers and for this reason as well, do not show the AFR of drives actually being shipped to
 2 consumers.²⁰ (Netel Decl., ¶¶ 21, 30-33, 38.)

3 **VII. Hospodor's Opinion that "Seagate's Reliability Testing Underestimated the True AFR**
 4 **of the Drive" Is Not Based on Sufficient Evidence nor Accepted Principles of Reliability**
 5 **Analysis**

6 67. In his Section IV.H, Hospodor asserts that Seagate's "reliability testing" and analysis
 7 was flawed because Seagate "used" or "assumed" a Weibull Beta value of less than 1—which
 8 "underestimated" the AFR of the drives—and instead, Seagate should have used a Weibull Beta
 9 value of > 1 to estimate AFRs for the Grenada drives. Hospodor's conclusions are based on
 10 misunderstandings or misrepresentations of Seagate's calculations of AFR, and accepted principles
 11 of reliability analysis, Weibull analysis and the Weibull parameters Beta and Eta. In particular,
 12 (a) Hospodor's opinion is based on the incorrect assumption that Seagate 'assumed' a Beta value,
 13 when in fact, Seagate always derived Beta from actual test data; (b) Hospodor's opinion makes no
 14 sense because using a Beta > 1 , as Hospodor insists Seagate should have done, would have given
 15 even lower AFR values; (c) Hospodor cites only three items of 'evidence' to support his conclusion,
 but his reliance on them is seriously flawed.

16 **A. Seagate Did Not 'Assume,' 'Select' or Use a Pre-Selected Beta Value of <1**

17 68. As explained above, the documents Hospodor cites clearly indicate that Seagate did
 18 not assume, select, or use a pre-selected Beta value, but instead, in every case, Seagate used
 19 maximum likelihood estimation to estimate the Weibull parameters Beta and Eta from actual test
 20 data on a specific group of drives. (Section IV.B, *supra*.) These facts were confirmed by Seagate's
 21 witnesses in deposition and in their declarations. (*Id.*)

22 69. Seagate used an appropriate, widely-accepted and widely-used methodology for
 23 determining Beta—MLE on actual test data. In each case, Beta was less than 1. (See Figure 2,
 24 above.) Hospodor claims that rather than using this method, Seagate should have ignored the Beta

25 _____
 26 ²⁰ Finally, the combined low average number of test hours (535 hours or 3 weeks rather than
 27 the full 6 weeks) could contribute to 'noisy' or even elevated results. Specifically, if drives exhibit
 28 "infant mortality" or early failures, then the drives will appear to have a high AFR early in testing,
 but as testing goes on, the drives that didn't fail will accumulate more time in testing and this will
 bring down the AFR. So a population of drives assessed at 535 hours (as these drives were) may
 exhibit a higher AFR than the same drives assessed after a full 1008 hours of testing.

1 values that were based on the actual test data, and selected some other, unspecified value “greater
 2 than 1.” (e.g., Hospodor Decl., ¶ 95.) Hospodor does not explain what value Seagate should have
 3 used, or what method Seagate should have employed to select a different Beta value. Hospodor
 4 provides no evidence or information to show that his suggested methodology—ignoring the actual
 5 test data and simply ‘selecting’ some other Beta value—is accepted or used in the industry or
 6 anywhere else. In other words, Hospodor provides nothing to show that his opinion is based on
 7 accepted or sound principles or methods of reliability analysis. It is not. It is completely baseless.

8 **B. Hospodor’s Opinion Makes No Sense**

9 70. Hospodor’s opinion is also fundamentally flawed because using or assuming a Beta
 10 <1 is actually pessimistic and conservative, and will give a higher predicted AFR (especially if the
 11 ‘true’ Beta is ≥ 1) compared to using a Beta of 1 or greater than 1. (See Paragraph 20 and Figure 1
 12 above.) In other words, if Seagate had done as Hospodor insists it should have done, and “used” a
 13 Beta greater than 1, Seagate would have calculated AFRs that were even lower than the AFRs
 14 reported in Seagate’s documents! Hospodor’s claim that Seagate “should have used” a Beta > 1
 15 makes no sense.

16 **C. Hospodor’s Three Pieces of Evidence Do Not Support His Opinion**

17 1. **The Sequence of “Increasing” AFRs**

18 71. In the last sentences in paragraph 85, Hospodor claims, “Seagate’s AFR went from
 19 2.34% to 2.621% and up to 3.436% within eight months after the start of mass production. This is a
 20 strong indication that the Drives were wearing out prematurely.” In paragraph 90 Hospodor repeats
 21 the sequence from paragraph 85 (with some typos) saying “failure rate actually increased from an
 22 AFR of 2/34% to 2.61% to 3.436%”. In Paragraphs 94 Hospodor claims that a Beta value of less
 23 than 1 “represents an assumption that the Drive will have a declining failure rate over time.” And in
 24 paragraph 95, Hospodor again claims that he AFR for the Grenada Classic drive “increased” over
 25 time “from 2.34% to 2.621% to 3.436%.” He claims this indicates “Seagate’s testing was flawed,”
 26 and that Seagate “should have used a β value greater than 1, rather than 0.608098.”

27 72. Hospodor misrepresents the sequence and his logic is clearly flawed. As noted,
 28 Seagate did not assume a Beta value but instead estimated by MLE using reliability test data.

1 Second, H ospodor mis-matches different AFRs to create the impression of a steadily increasing
 2 AFR. All of these values are taken from results of testing Grenada Classic drives, but H ospodor did
 3 not consistently use the same type of AFR estimate. Specifically, the first number is the ***Demo'd***
 4 ***Reduced*** AFR and the next two are the ***raw*** AFRs. (See Figure 2 above.) Furthermore, the first and
 5 last values are taken early in the tests when average test time is significantly less than 1000 hours
 6 such that AFR estimates can be systematically higher. It is clear that H ospodor mixed and matched
 7 the different estimates to create the impression that AFRs were “increasing.” The sequence of
 8 Demo'd AFR estimates was actually 2.34%, 0.95%, and 2.35%—which is not an increasing
 9 sequence and does not support H ospodor’s conclusions. Similarly, and although the raw AFRs do
 10 not represent the AFRs of drives shipped to consumers, the sequence of raw AFRs is 7.006%,
 11 2.621%, 3.436%—also not an increasing sequence.

12 73. Moreover, H ospodor’s entire analysis of the sequence of test results is based on a
 13 fundamental (and glaring) misunderstanding of reliability analysis and the Weibull distribution.
 14 H ospodor cites a sequence of projected AFRs from accelerated testing on ***three different***
 15 ***populations of drives all starting at 0 hours of testing*** and all ending at 1,000 hours or less of test
 16 time. (Almgren Decl., ¶ 23.) This sequence ***cannot be used to determine whether Beta is greater***
 17 ***than or less than 1.*** As explained above, the Beta parameter describes whether the failure rate is
 18 ***increasing or decreasing with greater amounts of “age,” i.e., time that the products are used or***
 19 ***tested.*** As explained, it is the equivalent of examining whether the rate of deaths increases or
 20 decreases ***as a population ages.*** H ospodor lists the AFRs from three different drive populations
 21 manufactured at different times, but all tested to roughly the same “age” (less than 1000 hours). He
 22 claims that because the AFRs were (allegedly) increasing across the three groups, this means that
 23 Beta was >1 and the failure rate was increasing ***with time in use (age of the drives).*** This is the
 24 equivalent of looking at the probability of dying *at age 10* in 1700, 1800 and 1900, and claiming
 25 that if this *annual* death rate went up between 1700 and 1900, this means that human *death rates*
 26 *increase with age*—e.g. that 40 year-olds have a higher chance of dying than 10 year-olds. This
 27 conclusion does not follow from the data. The probability of dying *as a 10 year-old* (the AFR) in
 28 1700 vs. 1900, does not tell you whether 10 year-olds have a higher or lower chance of dying ***than***

1 **40 year-olds.** Similarly, the AFR for drives manufactured in 2011 vs. those manufactured in 2012,
 2 does not tell you whether drives used for 6 months have a higher or lower chance of failing
 3 *compared to drives used for 2 years.* That Hospodor thinks that his sequence of three AFRs (from
 4 three different test populations of drives all tested to the same age) can be used to determine whether
 5 Beta was greater than 1 further demonstrates Hospodor's fundamental misunderstanding of accepted
 6 reliability analysis methodologies (in particular, the Weibull distribution and the significance of the
 7 Beta parameter). It is simply not possible to use the sequence of AFRs Hospodor cites to reach his
 8 stated conclusion that Beta was greater than 1 or that the drives were 'wearing out prematurely.'

9 74. Hospodor goes on to say in Paragraph 91 that Beta or the shape parameter is the more
 10 important of the two primary parameters in the Weibull distribution. This is not correct, as
 11 explained in Paragraph 37 above.

12 **2. Hospodor's Reliance on Khurshudov Is Misplaced**

13 75. Beginning in paragraph 96 through 111, Hospodor introduces and discusses former
 14 Seagate employee Andrei Khurshudov's ("Khurshudov's") report on "Product Failure Rate Trends
 15 and the Role of Workload Stress" from about June of 2012 at which time he worked for Seagate.
 16 First, Hospodor simply ignores the fact that the Khurshudov report's conclusions do not apply to
 17 consumer, desktop drives like Grenada. In fact, in his deposition, Khurshudov explained that for
 18 desktop drives used in consumer applications (like Grenada), ***his report showed that those drives
 19 always behaved as expected, with Beta less than 1.*** (Ex. 14 [Khurshudov Depo.] 126:23-129:10
 20 ("The thing is for the -- this client space, ***for desktops and mobile drives,*** this -- ***this study actually
 21 didn't show any even hints of wearout. The beta is always below 1.*** So the conclusion would be --
 22 and this is again part of this study -- ***it's a low workload environment, and drives behave exactly
 23 how we expect.*** It's our mission critical products that might be affected.")) Hospodor simply ignores
 24 what Khurshudov said about the conclusions of his own report, and then misapplies the report—to
 25 reach the opposite conclusion from what the report actually showed (which was Beta was less than 1
 26 on consumer, desktop drives).

27 76. Second, there are several flaws in the report that Hospodor incorrectly endorses.
 28 These are:

1 a. Hospodor endorses the statement shown in the slide in his Figure 11 that wear
 2 out phenomenon (where Beta >1) is highly undesirable. This idea is naive. “Wear out” is
 3 unavoidable; everything eventually wears out (or dies). The key to a successful product is
 4 that its characteristic life is long enough to meet service life expectations.

5 b. The data is based on returns, not failures. Returns include failures and non-
 6 failures, and non-failures can be a large fraction of the total. For example, another document
 7 by Khurshudov shows that over 75% of returned products can have no trouble found, and a
 8 large proportion may never have even been used. (Ex. 15 [FED_SEAG0002320] at 2327;
 9 Almgren Decl., ¶ 25; Ex. 14 [Khurshudov Depo.] at 36:25-39:14.) Furthermore some
 10 failures may not be returned. Drawing conclusions about failure rates from return rates is
 11 unreliable.

12 c. In Paragraph 100 Hospodor refers to the plot taken from Khurshudov’s report
 13 shown in Figure 12 of his declaration. (See Hospodor Decl., ¶¶ 101 and Figure 12.) Both
 14 Hospodor and Khurshudov incorrectly conclude that the curves are “exhibiting failure rates
 15 consistent with β increasing to and possibly surpassing a value of 1.” First, Khurshudov
 16 testified that he drew his conclusions by simply ‘eyeballing’ the graph in question, and
 17 drawing some lines, but did not do any mathematical analysis of the data. (Ex. 14
 18 [Khurshudov Depo.] at 88:17-90:1, 95:7-96:18, 96:23-97:23, 99:1-9.) Hospodor
 19 acknowledged in his deposition, that visual examination of graphs like Figure 12 cannot be
 20 used to make conclusions about Beta. (Ex. 11 [Hospodor Depo.], 88:10-96:10.) However,
 21 this is exactly what Khurshudov did, and Hospodor adopts Khurshudov’s unfounded,
 22 ‘eyeball’ opinions even though he acknowledges that Khurshudov’s approach is unsound.²¹
 23 (*Ibid.*) Moreover, all of the curves in this plot are consistent with Beta < 1. In fact, ***the
 24 graph at issue shows that Beta and/or the characteristic life (scale parameter Eta) are
 25 decreasing for the cumulative return data plotted.*** For example, Figure 4 below shows a
 26 constant Beta and a ***decreasing Eta***.

27 ²¹ Even Khurshudov noted on the slide at issue that more complete data analysis is needed
 28 to confirm his observation, yet Hospodor accepted the observation (which is methodologically
 unsound) without any further data analysis.

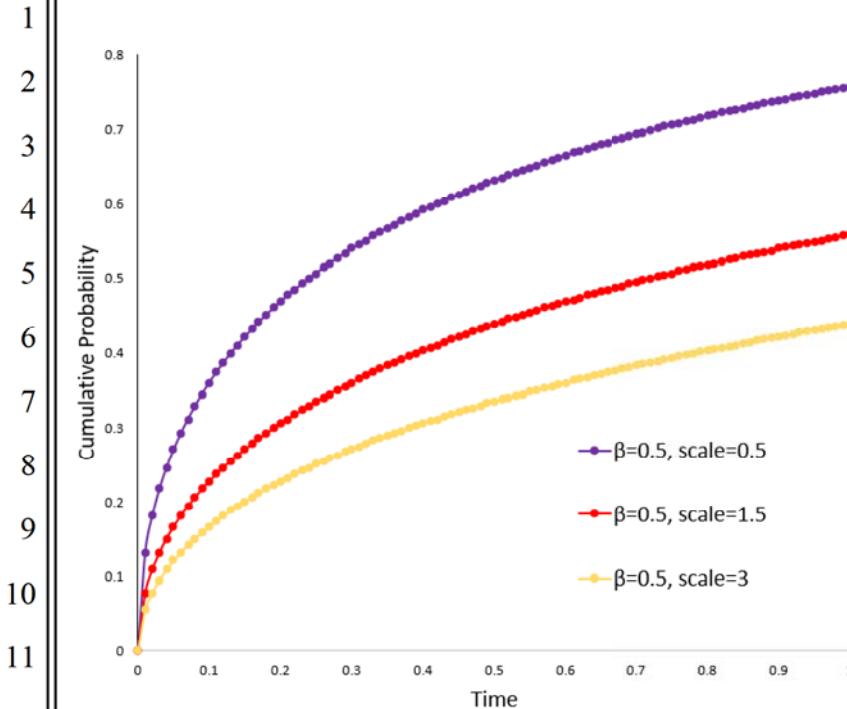


Figure 4. Shape parameter (β) held constant at 0.5; scale parameter (η) decreasing from 3 (gold line) to 1.5 (red line) and 0.5 (purple line). (Figure prepared using Excel and Excel's Weibull function.)

d. After adopting Khurshudov's incorrect 'eyeball' claim that Beta showed a "progression" from $\beta < 1$ to $\beta > 1$, Hospodor goes on to claim that "the data points of *the Grenada fall[j]in the $\beta > 1$ range.*" (See Hospodor Decl., ¶¶ 101.) Hospodor makes a conclusion about "the Grenada" drives even though Khurshudov refused to draw any such conclusion because there simply was not enough data about Grenada. (See Hospodor Figure 12 ("We should wait until we could make a conclusion about Grenada"); Ex. 14 [Khurshudov Depo.] at 99:25-101:10.) Moreover, as noted, Khurshudov explained that his report showed for consumer drives Beta was always less than 1 and the and the conclusions about Beta greater than 1 and wear out did not apply to desktop drives like Grenada. (Ex. 14 [Khurshudov Depo.] 126:23-129:10.) Hospodor's attempt to stretch Khurshudov's statements to cover Grenada drives lacks any reasonable basis and is not supported by the data.

e. Both Hospodor and Khurshudov repeatedly say that Weibull Beta or shape

1 values are ‘assumed.’ As previously discussed, this is simply not the case. (See Section
 2 IV.B.) It appears that Khurshudov was not involved in Seagate’s actual reliability testing or
 3 calculations of AFRs, so this may explain why he made misstatements about how Seagate
 4 actually determined Beta and AFR.²² (See Ex. 14 [Khurshudov Depo.] at 13:24-15:11;
 5 24:16-25:16.; Almgren Decl., ¶ 24.) At any rate, Khurshudov explained in his deposition
 6 that Beta and AFR are based on fitting the Weibull distribution to actual test data (Ex. 14
 7 [Khurshudov Depo.] 47:13-49:5.)

8 f. The emphasis both Hospodor and Khurshudov place on the Weibull shape
 9 parameter, Beta, while excluding the characteristic life, Eta, is not correct. At least two
 10 parameters are need to make a useful AFR projection, and the Eta parameter is just as
 11 important as Beta.

12 77. In Paragraphs 106 to 108 of his declaration, Hospodor references a suggestion by
 13 Khurshudov that “Longer-term reliability tests (~1 Year) might need to be introduced to gain more
 14 confidence in reliability projections.” ***But Khurshudov testified that this conclusion did not apply***
 15 ***to desktop or consumer drives like Grenada***—it only applied to high-workload, enterprise drives
 16 (Ex. 14 [Khurshudov Depo.] 126:23-129:10.) Furthermore, it is true that confidence in the
 17 projections can be improved this way and more knowledge of eventual wear out behavior and
 18 mechanisms can be gained. It is also true that increasing the number of test samples will improve
 19 confidence in the projections. However, there is no reason to think this was necessary to adequately
 20 test the Grenada drives and Hospodor provides no basis for so thinking. Certainly Khurshudov
 21 made no such conclusion. (*Id.*; *see also* Almgren Decl., ¶ 26.) Hospodor offers no basis for
 22 extending Khurshudov’s suggestion to consumer, desktop drives like Grenada, and I see none. First,
 23 for HDDs designed for enterprise use (data center applications, servers, cloud computing, etc.) both
 24 the number of samples and test time is increased in my experience. By contrast, Seagate’s RDT and

25
 26 ²² The only role in which Khurshudov was involved with reliability was a research role from
 27 2006 to May 2008, and that role did not involve analyzing reliability of any specific products.
 28 (*Ibid.*) At the time he wrote the report in question he was “senior director, cloud research and
 analytics” but Glen Almgren reports that—consistent with his title at the time—Khurshudov was not
 directly involved in RDT or product qualification and would not necessarily have known how
 Seagate determined Beta and AFR in those contexts. (Almgren Depo., ¶ 24.)

1 ORT reliability testing protocol for the Grenada drives—1000 HDDs for 1000 hours—has been
 2 widely accepted in the industry for drives like the Grenada drives that are intended for desktop
 3 computer applications.²³ Even Hospodor acknowledges that test protocols can be shorter than what
 4 Seagate used (30 days rather than 6 weeks). (Hospodor Decl., ¶ 34.) Furthermore, as explained,
 5 because Seagate tested the drives at maximum workload (and high temperature) for 6 weeks,
 6 Seagate subjected the drives to the equivalent of over 3 to 3.8 years of use and wear. This is more
 7 than sufficient to obtain data to project reliability characteristics of the drives over the expected
 8 useful life of the drives with reasonable accuracy. Other than his wholly incorrect application of the
 9 Weibull analysis (Paragraphs 41, 70-76), and his misplaced reliance on, and misapplication of,
 10 Khurshudov's incorrect conclusions (Paragraphs 75, 76), ***Hospodor provides no basis for asserting***
 11 ***that Seagate's testing of the Grenada drives was insufficient.*** Therefore, Hospodor's claims that
 12 Seagate's reliability testing was inadequate and that AFR projections were overly optimistic is not
 13 supported by his alleged evidence or arguments. Nonetheless Seagate also tested drives for
 14 extended periods of time (an additional 3-6 weeks after the normal 6-week test) to confirm that Beta
 15 remained below 1, which it did. (Almgren Decl., ¶ 28; Ex. 13 [Almgren Depo.], at 88:5-90:6.)

16 **3. The Grenada BP2 Test Results**

17 78. In paragraphs 112 to 117 Hospodor misinterprets the GrenadaBP2 reliability test
 18 results shown in Figure 14 of his Declaration. He incorrectly states “the AFR increased from
 19 1.039% in the first year to 1.951% in the fifth year.” The values for the second year (2Yr FR)
 20 through fifth year (5Yr FR) are ***cumulative failure probabilities (FR)*** projected by the Weibull CDF
 21 using estimated parameters based on the test data. They are consistent with an estimated shape
 22 factor, Beta, less than 1. Therefore his conclusions are mistaken.²⁴ Moreover, this document shows
 23

24 ²³ This test design is a good balance between cost of samples and equipment and schedule. For no failures during the test this demonstrates reliability of 0.998 with 90% confidence using the Binomial distribution. The annualized failure rate (AFR) for a product operated this much in one year would be less than 1%.

25 ²⁴ That the 2Yr FR to 5Yr FR are cumulative and not “annual” would seem obvious given
 26 that the first year value is “AFR” (the “annualized” failure rate), but the subsequent numbers are not
 27 labeled “AFR” and instead are labeled “FR.” In addition, the only way to arrive at any of these
 28 values is to use the Beta and Eta parameters to model the data and derive the AFR and FRs. The
 AFRs and FRs can't be “inconsistent” with the listed Beta, because the listed Beta was used to
 produce the AFR and FRs.

1 that when the Grenada BP2 drives were approved for general release as internal, desktop drives
 2 (Disty/OEM), the Demo' d first year AFR was 0.90%. Furthermore, the cumulative failure rate
 3 (probability) at the 5th year was less than 2%--meaning that even after 5 years of use, based on its
 4 RDT test data, Seagate projected that only 2% total of drives would have failed, while 98% would
 5 still be operational. This exceeds the goal in the table from the “5-year BIC Service Life Strategic
 6 Initiative.” (See Figure 3 above.)

7 **D. The Backblaze Blog Posts Do Not Support H ospodor’s Conclusions**

8 79. In Paragraph 104, H ospodor references Backblaze blog posts and implies that they
 9 support a conclusion that “the ST3000DM001 … were not as robust as the competition.”²⁵
 10 However, the blog posts do not support this conclusion. It is incorrect to conclude that Backblaze
 11 compared the Grenada 3TB drives to even a reasonable sample of competitor drives. For example,
 12 Backblaze did not use or “test” enough Samsung or Toshiba drives to even make a comparison, and
 13 Backblaze also excluded certain 3TB Western Digital drives from its analysis because they
 14 performed too *poorly*. (See <https://www.backblaze.com/blog/what-hard-drive-should-i-buy/> (“We
 15 don’t have enough Toshiba or Samsung drives for good statistical results” and later reporting that
 16 Backblaze excluded Western Digital 3TB Green drives because they failed so quickly.)) In fact,
 17 Backblaze only used one other brand of 3TB drives in any significant numbers (HGST), while
 18 excluding 3 brands (Samsung, Toshiba and Western Digital). One cannot conclude that the Seagate
 19 Grenada 3TB drives were less “robust” than “the competition” when Backblaze only used 1 of 4
 20 competitor brands but not the other three.

21 80. Moreover, Bakcblaze mishandled and misused the drives, and there are other
 22 problems with the blog posts. Seagate’s witnesses have explained that log data for drives Backblaze
 23 claimed had failed showed a high percentage of the drives with No Trouble Found (“NTF”)
 24 indicating that the drives were working properly and the failure rate was not what Backblaze
 25 reported. (Ex. 17 [Rollings Decl.], ¶ 7.) The boxes or “Pods” into which Backblaze inserted the
 26 Grenada 3TB drives (the Pod 2.0 design) was highly flawed, and subjected the drives to excessive
 27

28 ²⁵ H ospodor does not explain how the blog posts are relevant to his discussion of Beta—they are not.

1 vibration and potential mishandling. (*Id.*, ¶¶ 4, 5, 8, 9.) Backblaze admitted that it had
 2 subsequently redesigned the Pod 2.0 to reduce vibration, and that this significantly reduced drive
 3 failures even over a short period of time. (See <https://www.backblaze.com/blog/180tb-of-good-vibrations-storage-pod-3-0/> (stating that changes were made in the transition from the Pod 2.0
 4 design to the Pod 3.0 design to reduce vibration and that even within a few months, these changes
 5 resulted in a “**dramatic improvement** in overall system performance along with lower drive failure
 6 rates.”) This indicates that the long period of time (several years) that the Grenada 3TB drives were
 7 in the high-vibration Pod 2.0 design was likely a substantial factor in any failures Backblaze
 8 observed. Backblaze also admits it operated the drives in a commercial, high-workload 24/7
 9 environment—which is very different and much more stressful to the drives than typical consumer
 10 desktop use. (See Rollings Decl., ¶ 5)

12 81. Finally, Backblaze reports that it purchased over 80% of its ST3000DM001 drives
 13 **before** September 2012, and purchased all of them by the end of 2012. (See
 14 <https://www.backblaze.com/blog/3tb-hard-drive-failure/>.) Seagate approved shipments of Grenada
 15 BP drives in April and June 2012, and projected Grenada BP production would equal Grenada
 16 Classic production around September 2012. (Ex. 4 [FED_SEAG0026751] at p. 26787; Dewey
 17 Decl., ¶ 18.) This means that almost all of Backblaze’s drives were Grenada Classic drives
 18 manufactured in 2011 and 2012. Even if the Backblaze blog posts were credited (they should not
 19 be), the posts could not support conclusions about Grenada BP or BP2 drives, or drives
 20 manufactured after 2012.

21 **VIII. Hospodor’s Remaining Sections and Evidence Do Not Support Any Claims about the**
AFR of the Drives or Hospodor’s Claim that the Drives Were Released Prematurely or
Were ‘Unstable’ and ‘Unreliable’ (Hospodor’s Section IV.I)

23 82. As explained in the preceding sections, the data and documents Hospodor cites do
 24 not support his conclusions that any version of the internal, desktop drives had a higher than 1%
 25 AFR, or that any Grenada drives had a “higher than advertised” AFR. In the remainder of his
 26 declaration, Hospodor claims that other evidence (related to yield, ECRs, firmware releases, ship
 27 holds, etc.) shows that the drives were “unreliable” and were “released prematurely.” Importantly,
 28 none of the evidence Hospodor cites can support a conclusion that the AFR for any drives was

1 above any particular value, or that the AFR for the internal, desktop drives sold to the public was
 2 over 1%. Furthermore, the evidence he cites doesn't even support the vague statements that the
 3 drives were "unreliable" or "released prematurely." With one exception, the evidence he cites is
 4 also limited to Grenada Classic drives, from 2011-2012. Finally, Hospodor continues to
 5 misinterpret and/or misrepresent various Seagate documents.

6 **A. Yield Information (Hospodor's Section IV.I.1)**

7 83. In Paragraphs 119 to 126 Hospodor discusses yield and the potential impact on
 8 reliability for the ST3000DM001 HDDs. Hospodor admits that yields are not part of an AFR
 9 estimate with the Weibull distribution. (Ex. 11 [Hospodor Depo.], at 236:10-13.) Indeed, yield
 10 cannot be used to determine if the AFR for a product is above or below a particular number (like
 11 1%). The yield information Hospodor cites does is not evidence that the AFR was over 1% for
 12 internal, desktop Grenada drives.

13 84. Moreover, the yield information on which he relies is limited to yield information for
 14 the Grenada Classic (in 2011 and 2012). (Hospodor Decl., ¶¶ 199-125.) Hospodor references pre-
 15 release yield information and projections for the Grenada BP drives (in 2012), but does not analyze
 16 any post-release yield information on Grenada BP or BP2 or any yield information from after 2012.
 17 (Hospodor Decl., ¶ 126 citing Ex. 3 [FED_SEAG0026867].) (*See also* Dewey Decl., ¶¶ 20-28.)

18 85. Finally, low yield also does not mean the drives were 'unreliable.' First, alleged low
 19 yields do not mean that a product is "unreliable" or "defective" as Hospodor claims. Hospodor
 20 presents no **evidence** to support this claim. Nor does it have clear philosophical support. On the one
 21 hand, some people argue that if there is less margin in the design and/or manufacturing process, this
 22 will lead to lower yields and could also result in less field reliability. On the other hand, if tests and
 23 screening are more stringent than necessary, then this will also lower yields but could be tied to
 24 better reliability in the field (because only the very best products are allowed to make it to the field).
 25 If tests and screening are less stringent, yield will be higher, and parts or products that should have
 26 been rejected will make it to the field where they will fail. In this instance, higher yield could be
 27 associated with higher failure rates. In other words, there are scenarios in which low yield *could be*
 28 paired with low reliability, but there are also scenarios in which in which high yield *could be* paired

1 with low reliability, and in which low yield *could be* paired with high reliability. Yield alone is not
2 evidence of reliability or unreliability.

3 86. Second, Hospodor's analysis cites to "prime" yield numbers, not over-all yield
4 numbers, which gives a misleading impression that yields were much lower than they actually were.
5 What Hospodor misses is that modern HDD designs tailor the recording format (and hence areal
6 density) to the capability of individual head and disk combinations that emerge from the production
7 line. I can state from my experience working with other hard drive companies over the past 10-20
8 years that this has been widely practiced for more than fifteen years across the industry, and enables
9 drive manufacturers to utilize the full variability from production. This has allowed the top areal
10 density and capacity to be pushed to match the strongest combination of heads and media from the
11 production line, while using weaker combinations of head and media to be utilized at lower
12 capacities. In other words, drives that are tested as being able to meet the most stringent head/media
13 requirements are utilized as 3TB drives. The yields Hospodor references for 3 TB Grenada drives
14 were the prime yields—the 'cream of the crop' that met the highest areal density media and head
15 requirements. The balance of the drives were formatted at a lower capacities that were supported by
16 the capability of the heads and media at a prescribed error rate. (Dewey Decl., ¶ 24.) Drives could
17 also be reclassified if specific heads or platters were defective by disabling the defective parts. (*Id.*)
18 This sorting and formatting (called "waterfalling") is an automatic part of the HDD process test code
19 and **does not require** humans to "diagnose, repair and rework hundreds of thousands of defective
20 disk drives" as Hospodor claims in Paragraph 119. (Dewey Decl., ¶¶ 24-26.) Total throughput
21 yield is therefore a much higher number. Given Seagate's prime yields, and based on my
22 experience, I would expect that Seagate achieved throughput yields in the range of 90%, as required
23 to support the business. There is no reason to believe Seagate did not achieve these throughput
24 yields. Accordingly, Hospodor's statements that "a 43% yield indicates that the product was
25 immature, highly unreliable and should not have been released until a substantially higher factory

26

27

28

1 yield was achieved,” and others to the same effect in the section, are based on incomplete and
 2 outdated knowledge about modern HDD design and manufacturing.²⁶

3 87. Third, as Seagate’s witnesses explain, the yields Hospodor cites were from early in
 4 production, before production had ramped to full capacity. (Dewey Decl., ¶¶ 23-28.) Seagate
 5 expected yields to be low initially and to improve as production volumes increased, and the
 6 documents indicate this in fact occurred. (*Ibid.*) Allowing for yield improvement over early
 7 production is very common.

8 **B. Engineering Change Requests (ECRs) Are Not Evidence of AFR or that the**
Drives Were Unstable or Shipped Prematurely”

9 88. In Paragraphs 127-155 Hospodor argues that the number and timing of the
 10 engineering change requests (ECRs) for the Grenada Classic drive is evidence that the drive was
 11 “unstable” and “released prematurely.”²⁷

12 89. First, the number and pattern of ECRs cannot be used to determine AFR or as
 13 evidence that the AFR of the drives was over 1% or any other value.

14 90. Second, Hospodor’s analysis is restricted to Grenada Classic drives (in 2011 and
 15 2012). Hospodor’s discussion in Paragraphs 127-135 and 137-155 is confined to Grenada Classic
 16 drives (and 2011-2012). In a single paragraph (Paragraph 136), Hospodor claims that the Grenada
 17 BP had 732 ECRs, of which 696 were designated as “serious” and in his opinion, “this means that
 18 problems with the Drive continued.” Hospodor does not support his assertions or present the data.
 19 Hospodor does not disclose what the “problems” with the Grenada BP might have been, or how the
 20 number of ECRs (serious or otherwise) demonstrated the persistence of any particular “problem” or
 21 “problems.” Furthermore, Hospodor does not explain why he thinks the designation of “serious”
 22 means there was a “problem” with the drives. My review of the ECRs for the Grenada Classic
 23 drives indicates this can’t possibly be the case, since so many ECRs that had nothing to do with

25

 26 ²⁶ Hospodor’s lack of familiarity with modern manufacturing may be due to the fact that it
 27 appears he has not been employed in hard drive manufacturing since 2001, or it may be due to the
 28 fact that his background is more focused on software, firmware and systems aspects of hard drives
 not in-depth experience in manufacturing.

27 ²⁷ As Hospodor admits, the timing and number of ECRs cannot be used to calculate AFRs or
 28 to determine whether the AFR of the drives was above 1% (or any other value). (Ex. 11 [Hospodor
 Depo.] 251:18-21.)

1 quality or reliability were designated “serious.”²⁸ Furthermore, Hospodor conclusions are
 2 unsupported by any credible evidence.

3 91. Third, neither the number nor pattern of ECRs is surprising or problematic in my
 4 experience, and Hospodor’s contrary opinion appears based on nothing more than an outdated
 5 conception of how hard drive manufacturing ‘should’ be done. Hospodor also cites a few individual
 6 ECRs he claims show problems with the Grenada Classic drives, but in most if not all instances,
 7 Hospodor appears to misinterpret (or misrepresent) the ECRs. The ECRs do not indicate any
 8 pervasive issues with the drives.

9 92. In Paragraphs 127-135, Hospodor references ECR data for the Grenada Classic, and
 10 presents his analysis of the spreadsheet in FED_SEAG0027240 which lists the ECRs for the
 11 Grenada Classic drive. In Paragraphs 128-130 and his Figure 18, Hospodor presents a summary of
 12 the counts and statistics for various categories of ECRs. However, he does not explain why he
 13 chose to sort according to some fields (some ECR properties) but not others, and the ones he chose
 14 appear irrelevant. For example, it is irrelevant if a certain percentage of ECRs involve “electrical”
 15 or “mechanical” components of the drives, if the reason for those ECRs was simply to add
 16 additional sources, or respond to customer requests, or to adapt the drives to changing
 17 circumstances, or to lower costs or improve yields, etc. (See Netel Decl., ¶¶ 22-27 (explaining that
 18 ECRs are simply one measure of the complexity of the supply chain, the number of factories in
 19 which Seagate manufactured the drives, and the length of time drive designs are now kept in
 20 production); Dewey Decl., ¶¶ 29-33 (similarly explaining that the number of ECRs is a reflection of
 21 the manufacturing complexity, and Seagate’s adaptation of the drives to changing customer
 22 demands, environments and uses of the drives).) In my opinion, a relevant sort of the data in the
 23 spreadsheet should have been done on the “**ECR Reason**” field—to examine the reasons for the
 24 ECRs. I have done this, as shown below in Figure 5. This Figure shows that “**Quality/Reliability**”
 25 **was the reason for only 3.81% of the total number of ECRs**, indicating that, in fact, problems with
 26 quality or reliability motivated very few of the ECRs. Customer Unique Code CC accounted for
 27

28 Indeed, Seagate’s witnesses explain that they designated ECRs as “serious” for any
 number of reasons, and that it just meant the ECR shouldn’t be ignored. (Dewey Decl., ¶ 35.)

1 8.5%. (Customer code simply means an ECR done in response to a customer request. (Ex. 11.
 2 [Hospodor Depo.] at 249:12-16.) The second most common Reason was to “Allow Purchase/Build
 3 of Evaluation Parts,” which would be normal in the course of development and high volume
 4 manufacturing. Nothing in Hospodor’s analysis supports his conclusions.

Grenada		Count	Count%	CumCount%
ECR Reasons		Count	Count%	CumCount%
Improvement - Design Engineering	260	25.42%	25.42%	
Allow Purchase/Build of Evaluation Parts	119	11.63%	37.05%	
Document update	115	11.24%	48.29%	
Customer Unique Code CC	87	8.50%	56.79%	
Correct error	68	6.65%	63.44%	
Improvement - Manufacturing Process	55	5.38%	68.82%	
Initial Release	54	5.28%	74.10%	
Consume Inventory	49	4.79%	78.89%	
Incorporate Part/Assembly not meeting documentation requirements	41	4.01%	82.89%	
Improvement - Quality/ Reliability	39	3.81%	86.71%	
Label Update	19	1.86%	88.56%	
Inactivate CCs	18	1.76%	90.32%	
Customer Unique Code/Label CC	13	1.27%	91.59%	
Customer Request	12	1.17%	92.77%	
Change Status of BI	11	1.08%	93.84%	
Commonality	11	1.08%	94.92%	
Unique Test Requirements	10	0.98%	95.89%	
Manufacturing Process/yield improvement	9	0.88%	96.77%	
Customer Unique Label CC	8	0.78%	97.56%	
ASL - Add/Change Process	6	0.59%	98.14%	
Customer Change Control CC	5	0.49%	98.63%	
Cost Reduction	4	0.39%	99.02%	
ASL - Add/Change in Sub-Assemblies Suppliers	3	0.29%	99.32%	
Customer Unique Code/Cogen/Label CC	2	0.20%	99.51%	
ASL - New Part	1	0.10%	99.61%	
New Process station	1	0.10%	99.71%	
Ship Parts/Assy Prior to ECR effectivity	1	0.10%	99.80%	
Improvement - Tooling	1	0.10%	99.90%	
Customer Unique Congen/Label CC	1	0.10%	100.00%	
Grand Total	1023	100.00%		

24 **Figure 5.** Pareto of Reasons for Grenada ECRs based on the spreadsheet from FED_SEAG0027240.

25
 26 93. Hospodor claims that the plots in his Figures 19 and 20 are from the same
 27 spreadsheet discussed above. However, that spreadsheet does not have a date field, and Hospodor
 28

1 does not cite to any other document from which he obtained date information. Hospodor was
 2 unable to explain in his deposition the source of the data for Figures 19 and 20 and the explanation
 3 he offered is not correct, since the spreadsheet he cites does not contain tabs, and is not specific to
 4 any month, but instead contains all ECRs regardless of month. (Ex. 11 [Hospodor Depo.] at 248:4-
 5 19.)

6 94. Nonetheless, even crediting that Hospodor might have some legitimate explanation
 7 for how he created these graphs, the basic distribution and timing of the ECRs shown do not seem
 8 unusual in my experience. The Grenada Classic drives were approved for OEM/Disty release near
 9 the peak of the ECRs in Oct/Nov 2011. The volume of manufacturing for the drives would have
 10 been low at that point and was expected to ramp through at least the second quarter of 2012.
 11 (Dewey Decl., ¶ 23; Ex. 1 [FED_SEAG0026697] at p. 26700 (production in the last quarter of 2011
 12 was expected to be only 79,995 of the 3TB drives, which was expected to grow to 618,414 3TB
 13 drives in Q2 2012, and similarly the higher yielding 1TB drives were expected to ramp from
 14 110,830 drives in Q4 2011 to over 3.3 million in Q2 2012).) Accordingly, the bulk of the ECRs
 15 would have happened while production of the Grenada drives was increasing. This is fully
 16 consistent with my experience of modern manufacturing practices in which multiple sources and
 17 suppliers of each part continue to be qualified as production is ‘ramping.’ Hospodor opined in his
 18 deposition that in his experience, all suppliers and sources are qualified before a drive is approved
 19 for manufacturing, and at Quantum in the late 1990s, suppliers and sources would never be qualified
 20 during production. (Ex. 11 [Hospodor Depo.] at 107:3-16; 108:15-109:6; 231:25-234:10.) This
 21 belief appears to be the main basis for Hospodor’s assertion that the timing of the Grenada Classic
 22 ECRs was suspicious. I worked at Quantum at the same time as Hospodor. At that time, we would
 23 release new drives several times a year, so it made more sense to qualify suppliers before drive
 24 release, and if a new supplier or source was qualified after one drive was released, we would just
 25 wait a few months to incorporate that new supplier or source into the next drive that was under
 26 development. That system is no longer relevant or applicable. These days, manufacturers keep
 27 drives in production for much longer—several years—and don’t release new drives several times a
 28 year. Therefore, drives are designed to be flexible and adaptable, so that they can be modified over

1 the course of the years that they are in production to meet changing circumstances. Moreover,
 2 manufacturers now anticipate that they will need to continuously qualify suppliers and sources (even
 3 after product launch) to meet volume production, to improve costs and yields, and for any number of
 4 other reasons.²⁹ (See Netel Decl., ¶¶ 22-27; Dewey Decl., ¶¶ 29-33.) Hospodor's opinions are
 5 based on notions of drive development and manufacturing that are nearly two decades out-of-date.

6 95. Furthermore, I reviewed the available details in the ECR data for several of the
 7 specific ECRs Hospodor selected in his declaration. I found the following problems:

- 8 (a) [REDACTED]
- 9
- 10
- 11 (b) [REDACTED]
- 12
- 13
- 14
- 15 (c) [REDACTED]
- 16
- 17
- 18 (d) [REDACTED]
- 19
- 20 (e) I agree with Dewey's explanation of the ECRs at issue in Hospodor Paragraphs
 147-155 (ECR0148346, ECR 0149074, ECR0149636). (Dewey Decl., ¶ 36(e).)
 21 Hospodor's explanation of these ECRs does not match the text of the ECRs or
 22 any other evidence I have seen.
- 23

24 **C. Hospodor's Discussion of Firmware Revisions Does Not Support His Claims**
 25 **(Hospodor's Section IV.I.2(c))**

26 96. In Paragraphs 156-168 Hospodor claims the number of firmware releases (12
 27 releases) supports his conclusion that the Grenada drives were an "abnormally unstable product."³⁰
 28 He also points to two specific firmware releases allegedly indicating problems with the drives.

29 In no case are ***unqualified*** parts or vendors used in product for sale (and at the start of
 30 production, all parts must be qualified with qualified vendors). Regardless of the timing of
 qualification, sources, suppliers and parts are held to the same standards. (Netel Decl., ¶ 23.)

30 The number of firmware releases cannot be used to determine the AFR of drives, and it
 does not show whether the AFR of the drives was over 1% (or any other number).

1 97. First, the number of firmware releases cannot be used to determine AFR, and it is not
 2 evidence that the AFR of the drives was over 1% or any other value.

3 98. Second, the only firmware releases that Hospodor ties to possible “issues” with the
 4 drives both relate to the Grenada *Classic* drives in **early 2012**, and neither indicates anything more
 5 than limited issues with ***that version*** of the drive that were fixed early in 2012. (See Paragraphs 100,
 6 101 below.)

7 99. Third, Hospodor’s claim about the overall number of firmware releases is not
 8 reasonable. In paragraph 157 Hospodor says “The ST3000DM001 underwent at least 12 firmware
 9 updates.” He neglects to explain that this total includes the initial firmware release that went with
 10 each of the three versions of the Grenada drive, the Grenada Classic, GrenadaBP, and GrenadaBP2.
 11 In other words, each of these drive versions would have an initial firmware release to go with the
 12 new parts and electronics contained within each version of the drive. Excluding these three releases,
 13 there were 3 firmware revisions for Grenada Classic, 4 for Grenada BP, and 2 updates for Grenada
 14 BP2. (FED_SEAG0018735.) Hospodor admits that a few firmware releases per drive is not
 15 exceptional (Hospodor Decl., ¶ 161), so viewed in this way, the number of firmware updates is not
 16 excessive, and does not support Hospodor’s claims. (See also Dewey Decl., ¶ 37.)

17 100. As noted, Hospodor points to only two firmware releases that he claims show
 18 problems with the drives, both of which were firmware revisions for the Grenada Classic drives in
 19 early 2012. The firmware update of 1/11/2012 for Grenada Classic described in Hospodor’s
 20 Paragraphs 163 to 166 includes a correction for an SOC test port that was left unterminated.³¹ This
 21 sort of bug or failure is ‘repairable’ by resetting the HDD or recycling power. As stated in the
 22 change log, “This issue does not result in loss or compromise drive data.” (FED_SEAG0018735.)
 23 This sort of failure is annoying and needs to be fixed, but will be tolerable if the time between
 24 events is long. In fact an electromagnetically noisy environment is necessary to initiate the problem,
 25 so it may never occur for most users. (See also Dewey Decl., ¶ 38.) It should not result in a ‘dead’
 26 drive or lost data.

27
 28

³¹ In my experience it is not uncommon that this error might occur with complex systems
 such as an HDD.

1 101. The firmware update of 4/23/2012 described in Hospodor's Paragraph 167 and 168
 2 corrects a "corner case in the drive cache search hardware." It is identified as a hardware race
 3 condition in the interface ASIC or SoC. Race conditions are serious, but corner cases are ***very rare***
 4 and can take a long time to identify and debug because they depend on just the right sequence of
 5 events to occur. As such they will occur in the field very infrequently too, and affect very few
 6 customers. (*See also* Dewey Decl, ¶ 39.) The firmware update in question made several other
 7 improvements (including yield improvements). It is unclear that Seagate would have done the
 8 firmware revision simply to address the issue Hospodor identifies. Hospodor's characterization of
 9 the change is greatly over-blown.

10 **D. Hospodor's Discussion of Ship Holds Does Not Support His Opinion (Hospodor**
 11 **Section IV.I.2(d) and IV.I.d(e))**

12 102. In both Sections IV.I.2(d) and IV.I.2(e) (Paragraphs 169-180), Hospodor discusses
 13 ship holds for the Grenada Classic drive in 2011-2012.

14 103. First, the ship holds Hospodor cites are ***limited to 2011-2012***, and with one
 15 exception, Grenada ***Classic***.³²

16 104. Second, the ship hold procedure exists to catch possible problems and ***keep them***
 17 ***from reaching consumers***. It is common that a new product at a new areal density, in the case of
 18 Grenada Classic 1 TB/disk, will experience difficulties ramping production. Inevitably new
 19 problems arise as volumes increase from 1,000s to 10,000s to 100,000s to 1,000,000. Hospodor's
 20 evidence—confined to 2011 and 2012—is consistent with this. Furthermore, with the proper
 21 systems in place these can be found in the factory and fixed before customers see them. The issues
 22 Hospodor enumerates in subsections I.2.d and I.2.e highlight Seagate's controls and the actions
 23 taken by its organizations to that effect. (See Netel Decl., ¶¶ 28-39.) By contrast he would have us
 24 believe this is evidence that "the ST3000DM001 [drives were] was unreliable, unstable, and
 25 defective". The ship holds however, are evidence of drives being withheld from the market—***it is***

26

³² Document FED_SEAG0054864, dated July 19, 2012, references Grenada BP. The
 27 remainder of the ship holds Hospodor cites apparently reference Grenada Classic, and most predate
 28 the release of Grenada BP. Hospodor also cites two other documents from 2012: Exhibit 3
 [FED_SEAG0026751], at 26785, which concerns ORT on Grenada Classic drives in June 2012, as
 discussed above in Paragraphs 63, 64; and FED_SEAG0024743, which is a May 2012 document
 mentioning apparent comments of two Grenada Classic OEM customers..

1 *not evidence that problematic or “unreliable” drives were shipped to consumers.* The evidence
 2 instead illustrates Seagate’s organizational resolve to find and fix issues as they arise.

3 105. [REDACTED]

4 [REDACTED]

5 [REDACTED]

6 [REDACTED]

7 [REDACTED]

8 [REDACTED]

9 [REDACTED]

10 [REDACTED]

11 **E. H ospodor Does Not Support His Claim that Seagate Documents “Acknowledge”**
 12 **that the Drives Were “Unstable, Unreliable, and Defective” ” (H ospodor’s**
Section IV.I.2(f).)

13 106. [REDACTED]

14 [REDACTED]

15 [REDACTED]

16 [REDACTED]

17 [REDACTED]

18 [REDACTED]

19 [REDACTED]

20 [REDACTED]

21 [REDACTED]

22 **F. A Few Changed Specifications for the Drives Do Not Support H ospodor’s Claim**
 23 **that the Drives Were “Unreliable” (H ospodor’s Section IV.J)**

24 107. In this section, H ospodor argues that changes in a few of Seagate’s specifications for
 25 the drive—most at the very end or after the end of the class period (February 2016)—somehow
 26 show that there were problems with the drives. The conclusion does not follow from the evidence
 27 H ospodor cites. Changes in published specifications are not evidence that an HDD is unstable
 28 or unreliable. Changes frequently occur for many high technology products over time. Spec-sheets

1 typically include a clause that says “specifications are subject to change at any time without notice.”
 2 It is my experience that specifications will evolve over the life of a product, especially as new
 3 models are introduced over many years, as in this case, where various iterations of the drives were
 4 produced over 5-6 years. Furthermore, in some instances, Seagate modified the specifications from
 5 upper bounds that were so high they would be impossible to reach. An upper bound that is so high
 6 does not provide any useful information to users since it is impossible to achieve or will never be
 7 reached. For example, an instruction that a drive should not be stored at the center of the Sun does
 8 not provide useful information to users about how, and under what conditions, they should store
 9 their drives. In some instances, Seagate’s prior specification was of this type, and Seagate modified
 10 it to bring it more in the range of possibilities. These types of changes appear to me to be driven by
 11 a desire to make the specifications more relevant or useful.

12 108. H ospodor mentions a handful of specific specifications he claims were changed in a
 13 way that indicate that the drives were “unreliable.” As explained in the following paragraphs,
 14 H ospodor is wrong.

15 109. In Paragraph 199 on Maximum Case Temperature, H ospodor says that “[t]esting
 16 performed in 2011 showed that the ST3000DM001 case temperature was 38°C above ambient.” He
 17 neglects to mention the report is for the SBS Raptor product **enclosure** with an HDD inside. See
 18 Exhibit 16 [FED_SEAG0009095] which clearly concerns testing the drive enclosure for Raptor with
 19 the drive in it. In fact, if the drive were not in the enclosure, then this document couldn’t relate to
 20 the Raptor product, since the Raptor product was an external, USB “box.” This product was not
 21 released at the time because of this design problem with the enclosure. (Dewey Decl., ¶ 12.)
 22 H ospodor’s entire argument about case temperature rests on his mischaracterization of the
 23 documents concerning the Raptor enclosure. Since that product was not released at that time, the
 24 fact that it was over-temperature in that test is irrelevant. H ospodor’s subsequent calculations and
 25 conclusions are therefore seriously flawed.

26 110. H ospodor discusses Maximum Wet Bulb Temperature (“WBT”) at paragraph 200.
 27 In this case, Seagate’s prior specification—37.7°C—describes a condition that is **lethal to**
 28

1 **humans.**³³ It seems reasonable that it would have been revised downward. The new specification
 2 (26°C) is not “onerous” as Hospodor claims. First, Hospodor’s math is wrong. The National
 3 Weather Service provides a calculator that shows that an ambient temperature of 83°F at a relative
 4 humidity of 75% does not give a WBT of 78.8°F or 26°C as Hospodor claims. In fact, at 83°F, the
 5 relative humidity would have to be over 83% to reach Seagate’s WBT specification.³⁴ Second, wet
 6 bulb temperatures of over 80°F (26.6°C) are still dangerous to human health and are rarely exceeded
 7 in the US.³⁵ Thus, Seagate’s new specification should not be onerous. The new limit describes
 8 conditions that are miserable, verging on dangerous to human health, and rarely occur in the US, and
 9 so few consumers will be operating their drives in this environment.

10 111. In Paragraph 201, Hospodor discusses the Unpackaged Storage Specification.
 11 Unpackaged storage is not the same as storage in the hermetically sealed package in which Seagate
 12 ships its HDDs. The primary risk of unpackaged storage is absorbing water into the HDA in high
 13 humidity environments. This is primarily a specification for retailers, not consumers. Again, since
 14 a wet bulb temperature of 26°C verges on dangerous to human health *and is rarely exceeded in the*
 15 *US*, Hospodor does not explain how a limit of **60 days, unpacked**, in these conditions is an
 16 unreasonable limitation.

17 112. In Paragraphs 202 to 206 Hospodor addresses the Workload Rating contained in the
 18 Product Manual. I agree that the specification is poorly written and even ambiguous, but I don’t
 19 think it was intentional. The main point of this specification appears to be to say that workload is
 20 limited to 55TB/year.³⁶ This is reasonable, and did not change over the course of the relevant

21 _____
 22 ³³ See <http://advances.sciencemag.org/content/3/8/e1603322.full> (wet bulb temperature “of
 23 around 35°C for even a few hours will result in death even for the fittest of humans under shaded,
 24 well-ventilated conditions”).

25 ³⁴ See https://www.weather.gov/epz/wxcalc_rh [using a barometric pressure of 30 in, which
 26 is considered normal]. Hospodor’s calculation regarding Houston TX is also inaccurate.

27 ³⁵ Houston, Texas is one of the hottest and most humid metropolitan locations in the world.
 28 Singapore is the worst. Houston, Texas is hardly representative of conditions elsewhere in the US.
 29 See also <https://www.nytimes.com/2015/06/07/opinion/sunday/the-deadly-combination-of-heat-and->
 30 [humidity.html](https://www.nytimes.com/2015/06/07/opinion/sunday/the-deadly-combination-of-heat-and-humidity.html) (“we found that over the period from 1981 to 2010, the average American
 31 experienced about **four** dangerously humid days, with wet-bulb temperatures exceeding **80**
 32 **degrees.**”)

33 ³⁶ I think the confusing wording of this specification reflects the technical and marketing
 34 team struggling with a new idea and trying to get it right. Moreover, the specification for a limited
 35 workload per year (<55 TB) was relatively new for HDDs. It has been adopted from Flash storage

1 period. Rather, Hospodor's critique of the 55 TB/year limitation is based on misleading
 2 calculations. (See Hospodor Paragraph 206.) A comparison to MPEG video on DVD is helpful. A
 3 single layer DVD has a 4.7 GB capacity and ~2 hour play time. This is about 5 Mbps at HD quality.
 4 By comparison, 55 TB/year yields about 150 GB/day of data transfers. This is the equivalent of ~32
 5 **DVD movies per day**. I don't think this is a severe restriction on the typical consumer, even in a
 6 small RAID home media server.

7 113. Furthermore, Hospodor misrepresents the importance of the reference to 8760 POH.
 8 While the Product Manual contained a reference to 8760 POH, it did not specify an AFR (or MTBF)
 9 until 2015, at which point it is specified <1% AFR **for 2400 POH**. (Schweiss Decl., ¶ 10, 11 and
 10 Exs. 2-12.) Prior to 2015, when the Product Manual referred to 8760 POH, there was no AFR
 11 statement in that manual. (*Ibid.*) Some Data Sheets between 2011 and 2015 specified an AFR of
 12 <1%, but in conjunction with a 2400 POH per year. (Payne Decl., ¶ 12, 13, Exs. 26, 27; Schweiss
 13 Decl., ¶¶ 12, 13, Exs. 17, 18.)

14 **IX. Hospodor Does not Identify Any Defect or Other Issue Common to the Different Drive**
Versions, Products, or Across the Class Period

15 114. Hospodor admits he does not identify any problem common throughout the class
 16 period (2011-2016), or common to the products and drive versions at issue (Classic, BP, BP2). (Ex.
 17 11 [Hospodor Depo.] at 49:7-52:25, 54:17-55:5, 125:19-128:14; 255:3-256:16.) However, in his
 18 declaration, Hospodor makes numerous references to "head related" and "contamination" "issues."
 19 To avoid any doubt on this issue, Hospodor does not present any evidence that any such issues are
 20 common to or among any of the drives, or across the class period. Furthermore, Hospodor's various
 21 statements about "head related" and "contamination" "issues" are not technically sound, and
 22 suggests he does not understand hard drive operation or failure modes.

23 115. In Paragraph 79, Hospodor claims that 23 of the 129 failures listed in the Grenada
 24 Classic SBS SAD (Exhibit 1 [FED_SEAG0026697] on pp. 26704-05), were "head instability."

25
 26 devices where it is common due to endurance limitations for the underlying technology. HDD
 27 manufacturers have found it necessary to employ this workload limitation as new technology to
 28 increase areal density has been developed that impact endurance for magnetic recording. It also has
 become necessary because an increasing number of customers have been trying to (mis)use
 consumer class products in data center applications where workloads are high and operations are
 24/7.

1 Hospodor suggests that the head instability was due to contamination or lubrication problems.
2 Hospodor also claims that “head-related failures, in addition to contamination, was a recurring issue
3 with the Drives.” These claims are flawed. In my experience head instability (for magneto-resistive
4 head technology) refers to an “unstable” ***electrical output signal*** from the read-write head due to
5 issues related to the pinned magnet and/or domain noise in the sensor. This is consistent with the
6 reports of Seagate employees. (Dewey Decl., ¶ 9, 16; Almgren Decl., ¶ 15.) Furthermore, contrary
7 to Hospodor’s assertions, contamination and lubrication issues are not primary causes of head
8 instability. The occurrence of some head and media failure does not imply a problem with the
9 drives or that these failures are related or are related to any other failures in any other versions of the
10 drives.

11 116. Moreover, the documents Hospodor cites demonstrate that **the numbers of Grenada**
12 **drives exhibiting head instability was quite small** and refute any claim that head instability was a
13 “recurring” “issue” or “problem” with the drives. In the case of the Grenada **Classic** drives at issue
14 in Paragraph 79, Hospodor cites Exhibit 1 [FED_SEAG0026697], at page 26704-05. This
15 document states that Seagate observed failures due to head instability in MAT 1.2 and 1.3 testing.
16 However, the document also clearly states that Seagate made changes to correct the problems, and
17 that MAT 2.0 testing validated that Seagate had reduced the problem by at least 74%. (See Figure 6
18 below (Ex. 1 [FED_SEAG0026697] at p. 26704.)) This occurred before the drive was approved for
19 shipment to consumers. (See Ex. 1 [FED_SEAG0026697] at p. 26704.) Seagate’s employee
20 testified about this in his deposition. (Ex. 13 [Almgren Depo.] at 194:3-9.) Hospodor apparently
21 ignores the plain meaning of the document (and Seagate’s deposition testimony) when he claims
22 that “head instability” was a problem at this point.

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Issue	Fix Validation	# of Failures	% Fail	Eff. Factor
SPPL-043: HeadInstability MAT1.2/1.3	Validation based on MAT 1.2/1.3/BiC failure rate in first 180 hours vs. MAT 2.0	23	1.243%	74%
	Validation of 111 drives in V-Test with new			

Figure 6 (Ex. 1 [FED_SEAG0026697] at p. 26704.)

117. Similarly, “head instability” was *not* a prevalent problem for the BP or BP2 drives. (See Almgren Decl., ¶¶ 16, 17.) Exhibit 4 [FED_SEAG0026751], page 26757, contains a reliability summary for Grenada **BP** drives. It states that, prior to any corrective actions, 5 drives out of 1073 drives tested—only 0.47%—failed due to “head instability.” Furthermore, since these drives were subjected to 1008 hours (42 days) of testing, or the equivalent of ~3.5 years of use, this gives roughly 0.13% drives failing due to head instability per year. (Almgren Decl., ¶ 17.) Finally, in his Paragraph 116 Hospodor claims Exhibit 5 [FED_SEAG0057277], p. 57324, shows that “the top ‘issue’ in the above chart [for Grenada **BP2**] is related to contamination, and the third issue is head-related.” However, that page shows that, before any corrective actions, 6 of 1058—only 0.6%—of Grenada BP2 drives failed because of particle/contamination issues. (This is roughly 0.2% per year of use.) The document also shows that the “third issue” was the failure of **1 drive out of 1058**—only 0.095%—due to head stability issues. Therefore, while “head instability” was listed as a failure mode for each version of the Grenada drives, most of the head instability issues were fixed **before** the Grenada Classic was released, and the percentage of Grenada BP and BP2 drives with head instability issues was very small, even before the corrective actions that reduced the problems even further.

118. Hospodor’s claim that “contamination, was a recurring issue” is similarly unsupported by the evidence. Hospodor cites to only a scattering of unconnected documents that

1 mention contamination—like the document discussed above that mentions ‘contamination’ in the
 2 BP2 test results. These scattered references don’t support a conclusion that there was anything
 3 wrong with the drives, or Seagate’s quality control or manufacturing. “Contamination” is a non-
 4 specific term that can mean any number of *unrelated* phenomena. (Dewey Decl., ¶ 9; Almgren
 5 Decl., ¶¶ 17, 20.) In my experience, there can always be some contamination-related failures in any
 6 group of drives, and hard drive manufactures are always striving to reduce contamination.
 7 Hospodor doesn’t identify any specific kind of contamination that was a common problem for the
 8 Grenada drives, and the documents he cites don’t identify any such problem either. There is simply
 9 no negative implication that could be drawn from the few, scattered and unrelated references to
 10 “contamination” that Hospodor notes.

11 119. In Paragraph, 82, Hospodor attempts to equate “degraded head” and “particle induced
 12 media damage” with a “Head Crash”. He claims they are “among the top failures” as well. Neither
 13 of these statements are reasonable nor do they comport with the entries in the FE tables based on my
 14 inspection. “Degraded heads” and “particle induced media damage” are the 3rd and 4th most
 15 common failures, contributing 5 and 3 of 47 total failures—which is 11% and 6% *of failures*,
 16 respectively. Since 1360 drives were tested, only 0.36% and 0.2 % of the drives that were tested
 17 failed for these reasons. These are not overwhelming problems. Moreover, “degraded heads”
 18 “particle induced media damage” and “Head Crash” are not related phenomena. The degraded
 19 heads appear to be related to TA events (Thermal Asperities due to imperfections in the disk). The
 20 Corrective Action sounds like adjustment of the disk burnishing process to reduce the disk
 21 asperities. Particle induced media damage could be caused by any number of types of particles from
 22 any number of unrelated sources or causes. (Dewey Decl., ¶ 16.) Neither “degraded heads” nor
 23 “particle induced media damage” are or imply “head crash”—which is a specific and catastrophic
 24 failure mode that would have been listed had it occurred.

25 **X. Supplementation of Opinions**

26 120. The opinions expressed herein are my own, based on my current understanding of the
 27 facts and circumstances surrounding this matter and my review of the information listed in
 28 Appendix 2. I understand that discovery is continuing and I reserve the right to supplement this

1 declaration or revise my opinions in light of additional information or documents that may be
2 brought to my attention. I will consider any criticisms of my opinions or bases for my opinions
3 brought to my attention or offered by experts retained by Plaintiffs, which may cause me to revise or
4 supplement my opinions.

5 I declare under penalty of perjury under the laws of the State of California that the foregoing
6 is true and correct.

7 Executed on this 5th day of January, 2018, at Pleasanton, California.

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Donald Adams, PE

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APPENDIX 1

Consultant Curriculum Vitae

Donald E. Adams, PE

Expertise

- Embedded Systems Design and Development
- Hard Disk Drives
- Data Storage Systems
- Analog, RF and Digital Circuit Design/Analysis
- E&M Fields and EMC problems
- Probability, Statistical Analysis and DOE
- Data Communication Systems
- Magnetic Recording Systems
- Control Systems and Motor Controls
- Project Management
- Phase Locked loops & Delay Locked Loops
- ADC/DAC and Digital/Firmware Controls
- Power Converters, Controls and management
- Modem Sensors and MEMS Sensors
- AC/DC Magnetic Motors and Electrostatic MEMS Motors
- Analog and Digital Video
- Programming: Python, C, Basic, Assembly, Fortran, Matlab, SPICE, Excel

Professional Summary

Employment History

From: 2009 **Adams & Associates Consulting**
To: Present Pleasanton, CA
Position: *Independent Consulting Engineer*
Technical and business development services specializing in electronic systems for data storage, MEMS, consumer products and electric power/energy. Subject matter expert and witness for patents and cases involving electrical/electronic engineering.

From: 2011 **Western Digital**
To: 2015 Irvine, CA
Position: *Sr. Principal Engineer*
Electronic architectures and system requirements specifications for power management in HDD and Flash storage systems. Advanced electronic system architecture development. SI, PI and EMC consulting. Special projects management. New graduate engineer training and mentoring.

Consultant Curriculum Vitae

From: 2004 **NanoChip**
 To: 2009 Fremont, CA
 Position: *Vice President Engineering*
 Managed all engineering work and a Joint Development Program with Intel.

- Completed research and built an engineering team for the development of a probe storage memory device.
 - The technology is based on atomic force probes with ferroelectric media built with MEMS structures and processes in a system similar to a disk drive or HDD.
- This team made several significant technology and architectural breakthroughs which resulted in more than 75 patent applications.
- Technical feasibility was demonstrated by early 2008 and the team was moving into full product development when funding ran out at the end of 2008.

From: 2001 **Maxtor Corporation**
 To: 2004 Milpitas, CA
 Position: *Senior Engineering Director & Principal Engineer*
 Managed technology transfers and pre-development projects in the Advanced Technology Group.

- Finished Printed-Media-Self-Servo-Write transfer work started at Quantum after the merger with Maxtor. A derivative was implemented for all Maxtor product lines.
- Led the pre-development team for a 2.5 inch mobile computing HDD platform.
 - As an outgrowth of the mobile computing work I became the power management leader for all new products.

From: 1996 **Quantum Corporation**
 To: 2001 Milpitas, CA
 Position: *1999-2001: Senior Engineering Director*
 Co-founded the Consumer Electronics Business Unit as Chief Engineer. The group was chartered to find new non-PC applications and business opportunities.

- Led investments and co-development with TIVO, Replay, Panasonic and other brand name consumer electronics companies that created Personal Video Recorders and Digital Audio Jukeboxes.
 - Investments returned more than \$30M in the first 18 months.
- Developed core technology capabilities for digital video and audio data stream management. 1394AV technology and products were also developed and demonstrated.

Consultant Curriculum Vitae

- Ten patent applications came out of the group and several have been issued. Most of the technology has since been incorporated in all HDD product lines. (Silent seeks, embedded file systems, capacity and content security)
- Moved to the Advanced Technology Labs to lead the integration of Printed-Media-Self-Servo-Write technology, a critical new manufacturing technology, into multiple products across the entire business.
 - This technology reduced the incremental capital needed to produce HDDs by more than \$50M per year.

1996-1999: Engineering Director

Director for two development teams comprising more than 100 engineers and extended teams from manufacturing, process engineering, test engineering, materials, and marketing. Worked directly with MKE, Quantum's manufacturing partner in Japan. Annual budget >\$16M.

- Delivered four high volume 5.25" HDD products. Production yields were over 90%. Volume was ~1 Mu/quarter for each and generated over 15% gross margins.
- Concurrently advised two additional cross functional teams that developed two more high volume 3.5" HDD products.
- Served as HDD architect in the product and technology planning process for 1 year.
- Initiated and led several technical task teams that tackled critical multi-functional problems for the business division. (FIT, SMART, Sing-no-spin, Adapt' RO-Correction)

From: 1993 **SyQuest Technology**
 To: 1996 Fremont, CA
 Position: *Engineering Vice President*

From: 1990 **Iota Memories**
 To: 1993 Santa Clara, CA
 Position: *Vice President Engineering & Co-Founder*
 Private start-up developing data storage products acquired by SyQuest.

From: 1986 **Maxtor**
 To: 1990 San Jose, CA
 Position: *Program Manager & Read-Write Engineer*

From: 1983 **Tulin**
 To: 1986 San Jose, CA
 Position: *Engineering Director & Read-Write Engineer*

Consultant Curriculum Vitae

From: 1981 **Ampex**
 To: 1983 Redwood City, CA
 Position: *Senior Staff Engineer, Read-Write*

From: 1978 **Memorex**
 To: 1981 Santa Clara, CA
 Position: *Senior Electronic Engineer, Read-Write Channels*

From: 1973 **Amdahl**
 To: 1978 Sunnyvale, CA
 Position: *Test Equipment Development Manager, Senior Test & Associate Engineer*

Consulting History

From: 10/17 **Sentient Energy**
 To: present Burlingame, CA
 Duties: Review of IEEE 495 testing for Fault Circuit Indicator product.

From: 3/12 **Intel**
 To: 9/12 Santa Clara, CA
 Duties: System architecture development and design reviews.

From: 4/10 **Samsung, SISA**
 To: 9/11 San Jose, CA
 Duties: Advisory engineer for HDD technology and magnetic recording. Signal integrity evaluation of high speed DDR2 buss and recommendations to improve products and the development process.

From: 3/11 **Superstar Productions**
 To: 6/12 Miramar, FL
 Duties: Hardware and firmware development using IRdA and a 16 bit microcontroller for a consumer electronics product.

From: 2/11 **Test Equipment Plus**
 To: 12/11 La Center, WA
 Duties: Development of MEMS based thermocouple RF and Microwave power sensor.

From: 3/10 **Voxis for Topcon**
 To: 12/10 Richmond and Livermore, CA
 Duties: Developed prototype hardware and MatLab routines for a new machine vision feature to be used on Total Stations/Scanner tools for civil engineers and surveyors. Prototype was successfully demonstrated and field tested.

Consultant Curriculum Vitae

From: Summer 09 **Private Investor**
 Duties: Evaluation and development of a prototype tracking solar thermal electric power converter based on a concept using the Seebeck effect.

Patents

<u>Patent Number</u>	<u>Issue Date</u>	<u>Title</u>
9,422,668	9/13/2016	Adaptive Power Management Control with Performance Feedback
9,280,200	3/8/2016	Automatic Peak Current Throttle of Tiered Storage Elements
8,264,941	9/11/12	Arrangement and Method to Perform Scanning Readout of Ferroelectric Bit Charges
7,796,493	9/14/10	Cantilever on Cantilever (MEMS) Structure
7,738,350	6/15/10	Probe Storage with Doped Diamond-like Carbon Medium and Current Limiter
7,310,196	12/18/07	Parking a Transducer Responsive to a Park Signal
7,280,301	10/9/07	Temperature Estimator for Electronic Device
7,196,862	3/27/07	Coherent Phase Data Segment Layout in Data Storage Device
6,487,646	11/26/02	Apparatus and Method Capable of Restricting Access to Data Storage Device
6,195,732	2/27/01	Storage Device Capacity Management

Education

<u>Year</u>	<u>College/University</u>	<u>Degree</u>
1983	Santa Clara University, Santa Clara, CA	MS, Electrical Engineering
1976	San Jose State University, San Jose, CA	BS, Electrical Engineering (with Distinction)

Publications

1. B. Kim, D. Adams, Q. Tran, Q. Ma, V. Rao, "Scanning probe charge reading of ferroelectric domains," *Appl. Phys. Lett.*, v. 94(6), 063105, 2009.
2. B. Kim, D. Adams, G. Tchelepi, Q. Tran, Q. Ma and V. Rao, "Scanning Probe Charge Reading of Ferroelectric Polarization with Nanoscale Resolution," 2009 NSTI Nanotechnology Conference and Expo, May 3-7, Houston, TX, (2009)
3. D. Adams, N. Belov, T-K. Chou, J. Heck, B. Kim, G. Knight, Q. Ma, V. Rao, G. Tchelepi, "Nanochip: A MEMS-based Ultra-High Data Density Memory Device," 2009 NSTI Nanotechnology Conference and Expo, May 3-7, Houston, TX, (2009).
4. N. Belov et al., "Thin-layer Au-Sn solder bonding process for wafer-level packaging, electrical interconnections and MEMS applications," *Int. Interconnect Technology Conf.*, Sapporo, June 2009.

Consultant Curriculum Vitae

5. S. Severi et al., "CMOS compatible poly-SiGe cantilevers with read/write system for probe storage device," *Transducers 2009*, Denver, June 2009.
6. N. Belov, D. Adams, D. Ascanio, T-K. Chou, J. Heck, B. Kim, G. Knight, Q. Ma, V. Rao, J.-S. Park, R. Stark, G. Tchelepi "Nanochip: A MEMS-based Ultra-High Data Density Memory Device," *Advanced Technology Workshop "Advanced Materials and Technologies for Micro/Nano Devices, Sensors and Actuators*, St.-Petersburg, June 2009.
7. D. Adams, N. Belov, T-K. Chou, J. Heck, B. Kim, G. Knight, Q. Ma, V. Rao, G. Tchelepi, "Nanochip: A MEMS-based Ultra-High Data Density Memory Device" – *future publication in "Sensors and Transducers."*

Professional Associations and Achievements

- Member, IEEE
- Eta Kappa Nu, Electrical Engineering Honors
- Registered Professional Engineer in Calif. # E19198

Adams & Associates

Pleasanton, CA

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donaldadams@sbcglobal.net

APPENDIX 2

Documents Considered

Pleadings and Deposition Transcripts

July 26, 2017 30(b)(6) Deposition of Glen Almgren.
September 7, 2017 Personal and 30(b)(6) Deposition of Patrick Dewey.
September 8, 2017 Deposition of Andrei Khurshudov.
December 15, 2017 Deposition of Andrew Hospodor
June 30, 2017 Declaration of Alan Ng (Case No. CGC-15-547787)
June 30, 2017 Declaration of Dave Rollings (Case No. CGC-15-547787)
January 5, 2018 Declaration of Mary Paneno (Case No. 3:16-cv-00523-JCS)
January 5, 2018 Declaration of Patrick Dewey (Case No. 3:16-cv-00523-JCS)
January 5, 2018 Declaration of Glen Almgren (Case No. 3:16-cv-00523-JCS)
January 5, 2018 Declaration of Harrie Netel (Case No. 3:16-cv-00523-JCS)
January 5, 2018 Declaration of Lien Payne (Case No. 3:16-cv-00523-JCS), and exhibits thereto
January 5, 2018 Declaration of Jeff Fochtman (Case No. 3:16-cv-00523-JCS), and exhibits thereto
January 5, 2018 Declaration of Karl Schweiss (Case No. 3:16-cv-00523-JCS), and exhibits thereto

Books and Websites

An Introduction to Applied Probability, Ian F. Blake, 1979
National Institute of Standards and Technology (“NIST”)/SEMATECH e-Handbook of Statistical Methods, <http://www.itl.nist.gov/div898/handbook> see also <http://www.itl.nist.gov/div898/handbook/apr/apr.htm>
“Life Data Analysis Reference” produced by ReliaSoft Corporation in Tucson, Az., 5/22/2015 <http://www.ReliaSoft.com>
<http://www.weibull.com/basics/parameters.htm>
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